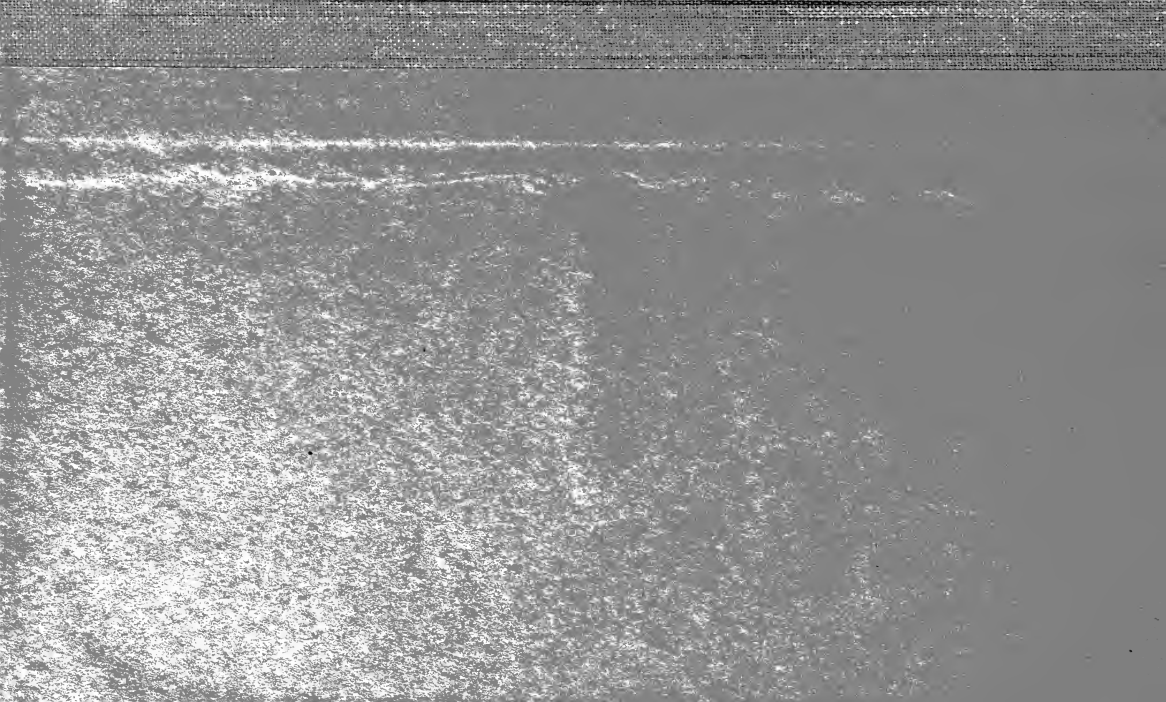


(Vogel)

AMERICAN EDITION.

PHOTOGRAPHER'S

POCKET REFERENCE-BOOK

AND

DICTIONARY:

AN

ALPHABETICALLY ARRANGED COLLECTION

OF

PRACTICALLY IMPORTANT HINTS ON THE CONSTRUCTION OF THE GALLERY; SELECTION AND TRIAL OF LENSES AND CHEMICALS; APPROVED FORMULÆ FOR THE DIFFERENT PHOTOGRAPHIC PROCESSES; TABLES OF WEIGHTS AND MEASURES; RULES FOR AVOIDING FAILURE; ETC., ETC.

FOR

PHOTOGRAPHERS AND AMATEURS.

BY

DR. HERMANN VOGEL,

Professor of Photography in the Royal Technical Academy at Berlin.
Editor of the "Photographische Mittheilungen."

TRANSLATED FROM THE GERMAN

BY

EDWARD F. MOELLING.

PHILADELPHIA:

BENERMAN & WILSON.

1873.

SHERMAN & CO., PRINTERS,
PHILADELPHIA.

PREFACE

TO THE GERMAN EDITION.

By an uninterrupted intercourse with many practical photographers, assistants, and scholars, I observed that the best of handbooks on photography, and the most instructive periodicals, leave a want, in so far as it is a matter of difficulty to find exactly that which is required at the moment.

Useful directions on the construction of the gallery; on the preparation of the collodion and silver bath; the causes and the remedies of failures in the positive and negative processes; dry-plate process; instructions on the selection and use of the objectives, &c., are often lost, *because they are not readily found.* There is not sufficient time at one's disposal to read whole pages in order to discover the particular line which is wanted. I have endeavored, therefore, to collect, in alphabetical succession, in a small pocket volume, everything important for the photographer; and nobody can remain in doubt where to look for the particular information he desires.

In this little work numerous notices have been embodied which have not been published heretofore, and which I have collected during my long practical career.

The knowledge of the practice of photography is presupposed; and based on this supposition, I have sketched the different processes in but a few words, leaving the details to be examined in my "Handbook," or the periodicals to which I have referred in the text.

The metrical system of weights and measures has been generally adopted throughout this book, although in many instances the corresponding quantities, expressed in grains, drachms, ounces, and pints, have also been given.

In giving the chemical symbols, I have adhered to the older form.

Dr. H. Vogel.

Berlin, August, 1872.

PREFACE

TO THE AMERICAN EDITION.

For the use of the English and American photographer, the German work has not only been translated, but revised and enlarged by the author. It may be considered a second and improved edition of the first book.

For a correct translation I am indebted to Mr. E. F. Moelling, of Philadelphia.

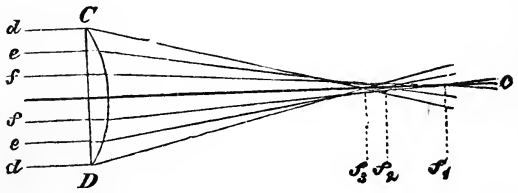
PROFESSOR H. VOGEL.

BERLIN, 1873.

Aberration, Chromatic, is the stronger refraction of the violet and blue rays when compared with the red and yellow. It is avoided by a careful combination of different kinds of glass, crown and flint. (See Vogel's *Handbook*, page 55; *also* Chemical Focus.)

Aberration, Spherical, is the greater refraction which the marginal rays suffer, in passing through a lens, when compared with the central ones.

Fig. 1.



The result is that the marginal rays *d d* have a shorter focus than the central rays *f f;* the former unite at f_3, the latter at f_1. If the ground-glass is placed at f_1, the central rays will form a sharp image, but the marginal rays will form a circle of diffusion which will make the

picture look blurred. This want of sharpness increases in the reversed proportion of the square of the focus and the cube of the diameter of the lens. The fault is therefore lessened by using a diaphragm (stop) and by lengthening the focus.

Acetate of Soda (*see* Soda, Acetate of).

Acetic Acid (*see* Glacial Acetic Acid).

Acetic Acid, Glacial. $C_4H_4O_4$. A clear, strong-smelling fluid; congeals at 15° Celsius; mixes in all proportions with water; in photography it is principally used for the developer. A substitute for acetic acid in the developer is spirits of vinegar, *i. e.*, water with 5 to 15 per cent. of glacial acetic acid; the necessary quantity of iron is dissolved in it. But the percentage of acetic acid in the spirits of vinegar has previously to be ascertained by the specific weight, *q. v.*, and the following table:

Percentage of Glacial Acetic Acid.	Specific Weight of Spirits of Vinegar.	Percentage of Glacial Acetic Acid.	Specific Weight of Spirits of Vinegar.
1	1.001	10	1.015
2	1.002	11	1.016
3	1.004	12	1.017
4	1.005	13	1.018
5	1.007	14	1.020
6	1.008	15	1.022
7	1.010	16	1.023
8	1.012	17	1.024
9	1.013	18	1.025

Ag. The chemical symbol of silver (*which see*).

AgO. The chemical symbol of oxide of silver.

$AgONO_5$. The old chemical symbol of nitrate of silver.

$AgNO_3$. The modern chemical symbol of nitrate of silver.

Al. The chemical symbol of Aluminum.

Albumen. The principal part of the white of egg; is also contained in the blood, and when dried it is sold as blood or egg albumen; it is soluble in cold water, decomposes rapidly, congeals at 60° or 70° Celsius, is precipitated by alcohol and salts of silver, which render it insoluble (coagulates).

Albumen Dry-Plate Process. According to Mr. England (*Photographic World*, December, 1872, Dr. Vogel's letter, page 368), albumenized plates are coated with a good bromo-iodized collodion, sensitized and washed; they are next coated with a well-shaken and filtered albumen solution (30 grammes of albumen to 90 grammes of water, 5 drops of ammonia); this is rinsed off again, and nitrate of silver solution (1 gramme of silver, 16 grammes of water, 6 drops of acetic acid) is poured over it; finally, the plates are washed and dried.

Development.—1 gramme pyrogallic acid, 250 grammes water. This is left on the plate until a weak, red picture appears; it is intensified with pyrogallic acid and citric acid.

Albumen Negatives and Transparent Positives. A clean glass plate is coated with the following solution:

Albumen,	1 litre.
Iodide of Potassium,	10 grammes.
Iodine,	½ "

The plates are left to dry in a place free from dust, and preserved for future use, guarding them against dust. They are sensitized with:

Water,	100 grammes.
Nitrate of Silver,	6 "
Glacial Acetic Acid,	12 "

(One-sixth as much nitric acid preferable.)

After they have been sensitized, they are washed and dried.

Exposure.—Transparent positive under a negative in sunlight from one to ten seconds.

Development.—1 gramme gallic acid, 500 grammes water; heated in a dish to 50° Celsius, in which the plate is placed.

Intensifying.—The same solution, cold, with a few drops of silver solution added.

Fixing as usual.

Toning with a diluted solution of chloride of gold, 1:400.

The process requires great cleanliness and care.

Albumenizing Glass Plates. This process takes the place of polishing. The white of a fresh egg and sixteen grammes ammonia are placed into a bottle along with some splinters of clean glass; the contents are shaken for a quarter of an hour, and diluted with forty volumes of distilled water. The concentrated solution will keep above three months. Before using it a portion of it should be filtered twice. The glass plates are acidulated, well washed, and placed in a dish with clean water. For the purpose of albumenizing them, they are taken out of the water; after being drained a little *distilled* water is poured over them in order to remove the adhering ordinary water; next we pour over the plate a little of the albumen solution to remove the distilled water, and finally the plate is coated with a second portion of albumen solution, in the same manner in which we coat a plate with collodion, but with the difference that the excess is not returned to the stock-bottle, but thrown away. The plates are next placed on a rack and left to dry, care being taken to protect them from dust.

Albumen Paper. 8 parts of white of egg, 2 parts of a solution of 10 parts of chloride of ammonia in 100 parts

of water, are mixed together and beaten to a froth, left a few hours to stand, and the clear liquid is poured into a dish. A sheet of paper is floated on this mixture for a minute and a half. The albumen paper of commerce is distinguished by the different weight, according to the lighter or heavier paper having been employed (8 kilo. to 10 kilo.), and also by its brilliancy depending on a thicker or thinner coat of albumen, *i. e.*, if the albumen has been diluted with a greater or lesser quantity of water.

Albumen paper should be kept in a dry place. Previous to using it, it should, however, remain twenty-four hours in a damp cellar, in order to absorb moisture, as otherwise blisters are easily formed in the fixing bath.

Washed Albumen Paper (*see* Permanent Sensitive Albumen Paper).

Permanent Sensitive Albumen Paper.—a. Citric Acid Albumen Paper.—Albumen paper is sensitized on the following solution: Nitrate of silver, 10 grammes; water, 100 grammes; when dry, it is floated again on a solution of citric acid 1:48, and left to dry. The following method is better:

b. Albumen paper is sensitized on an ordinary strong bath of nitrate of silver; it is afterwards washed in four changes of water, and dried. Such paper keeps for months. It is fitted for printing by fuming with ammonia, or also by placing in the printing-frame at the back of the paper a cushion or pad containing pulverized carbonate of ammonia (*which see*).

Alcohol is used to make collodion, and is added to the developer. Specific weight, 0.809; boiling-point, 78.4° C. Alcohol containing water is heavier and not so volatile. The amount of water contained in alcohol is determined by the alcoholmeter. Photographic alcohol, so-called absolute, contains five per cent. of water, which does not do any harm. Fusel oil in the alcohol is injurious to collodion; it is detected by the smell.

TABLE *giving the Specific Weight of different mixtures of Alcohol and Water, and the corresponding amount of Alcohol expressed in percentage of volume at the Standard Temperature of* 16° *C.*

Specific Weight.	100 Volumes of Alcohol contain Volumes of Water.	Specific Weight.	100 Volumes of Alcohol contain Volumes of Water.	Specific Weight.	100 Volumes of Alcohol contain Volumes of Water.
0.9348	50	0.8978	67	0.8530	84
0.9328	51	0.8954	68	0.8500	85
0.9308	52	0.8930	69	0.8470	86
0.9288	53	0.8905	70	0.8440	87
0.9267	54	0.8880	71	0.8409	88
0.9247	55	0.8855	72	0.8377	89
0.9226	56	0.8830	73	0.8344	90
0.9205	57	0.8804	74	0.8311	91
0.9183	58	0.8770	75	0.8277	92
0.9161	59	0.8752	76	0.8242	93
0.9139	60	0.8725	77	0.8206	94
0.9117	61	0.8698	78	0.8169	95
0.9095	62	0.8671	79	0.8130	96
0.9072	63	0.8644	80	0.8089	97
0.9049	64	0.8616	81	0.8046	98
0.9026	65	0.8588	82	0.8000	99
0.9002	66	0.8550	83	0.7951	100

Am. The chemical symbol of ammonium, NH_4. Not much in use.

Amber Varnish (*see* Varnish).

Ammonia is used for fuming paper, albumenizing plates, and also for cleaning plates (9.0).

Ammonia, Bichromate of. A reddish-brown salt, crystallized. Dissolves readily in four parts of water; is also soluble in alcohol. Is employed in "lichtdruck" printing. For a table to determine the strength of solutions of chromate of ammonia, *see* Potash, Chromate of.

Ammonia, Carbonate of, is also used for fuming paper. The best method is that of Dr. Vogel, of placing a

cushion containing powdered carbonate of ammonia at the back of the paper into the printing-frame. (See page 9.)

Aniline Printing Process, for copying positives from positives (drawings, &c.):

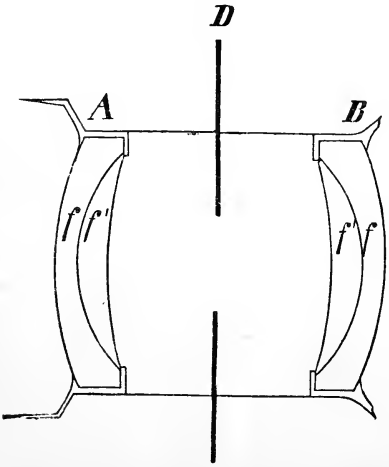
Red Chromate of Potassium, ...	1 part.
Solution of Phosphoric Acid, sp. grav., 1.124, .	8 "
Water, ...	12 parts.

Steinbach paper is floated one minute, and left to dry. Printing with photometer. Fumigating with 30 grammes of benzine and 30 to 40 drops of aniline.

Aplanatic. Lenses are called aplanatic when free from spherical aberration.

Aplanatic Lens is the name of an objective made by

FIG. 2.



Size by French measurement, 1′ = 324 millimetres.

Steinheil for architectural and landscape photographs and

reproductions (for construction, see Fig. 2); front and back lenses are alike. It draws perfectly correct; the relative opening is one-seventh (*see* Relative Opening); in the smaller, Nos. 1 to 4 (see below), the picture, to the extent of 45°, is perfectly sharp; the field of view is 65° (Report of the Committee of Examination, see Vogel's *Handbook*, page 72). The lens has twice as much light as Dallmeyer's triplet, and for the same sized picture it is cheaper. Focussing is done with the full opening. Portraits can only be made with a good light and full opening.

	Opening.	Focus.	Landscape Picture.	Portrait Picture.
No. 1	7 lines	$3\frac{1}{2}''$	$3\frac{1}{2}$ x $3\frac{1}{2}$	$2\frac{1}{2}$ x 2
" 2	11 "	$5\frac{1}{4}$	$5\frac{1}{2}$ x 5	$3\frac{1}{2}$ x $2\frac{3}{4}$
" 3	14 "	7	$7\frac{1}{2}$ x $6\frac{1}{2}$	$4\frac{1}{2}$ x $3\frac{1}{2}$
" 4	19 "	$10\frac{1}{4}$	$10\frac{1}{2}$ x $8\frac{1}{2}$	$6\frac{1}{4}$ x $5\frac{1}{2}$
" 5	23 "	$13\frac{1}{4}$	$11\frac{1}{4}$ x $9\frac{1}{2}$	8 x $6\frac{1}{2}$
" 6	27 "	$16\frac{1}{4}$	12 x $10\frac{1}{2}$	$9\frac{1}{2}$ x $8\frac{1}{2}$
" 7	39 "	$23\frac{1}{2}$	16 x 12	14 x $11\frac{1}{2}$
" 8	51 "	31	21 x 16	$16\frac{1}{2}$ x 12

Lately Steinheil has made wide-angled aplanatic lenses, particularly for the reproduction of reversed drawings for the "lichtdruck" process. (*See* Wide-Angle Lenses.)

Arrowroot. Starch of the arrowroot is used for coating a dull paper. 100 parts of water, 3 parts chloride of sodium are heated to boiling; $3\frac{1}{2}$ parts arrowroot are added, well stirred and strained through a cloth. It is placed on the paper with a brush and laid on crossways.

Arrowroot Paper, Printing on it. Sensitizing at most but for a minute; printing as usual; toning in a very diluted gold bath—solution of a salt of gold (*see* Toning Bath).

Asphaltum. A black earth resin; a mixture of different not yet well known hydrocarbons, the most im-

portant of which is probably anthracene. Asphaltum is insoluble in water, partially soluble in alcohol, but more readily in ether; it is most soluble in benzine, oil of turpentine, and chloroform. The solutions, distributed on a plate of glass, give a film which becomes insoluble when exposed to light. On this quality a branch of heliography and photolithography is based.

Asphalt Dishes. Wooden dishes made water-tight with asphaltum. Perfectly dry boxes, made of linden or poplar wood, are selected, and are coated with a diluted solution of Syrian asphaltum, dissolved in oil of turpentine. A second, third, and fourth coat is applied as soon as dry. Pasteboard used for the same purpose should first be coated with linseed oil varnish.

These dishes resist all the photographic chemicals. Solutions of nitrate of silver should, however, not remain too long in them.

Atelier (*see* Gallery).

Au. Chemical symbol of gold.

Awnings, for protecting the skylight from the direct rays of the sun, are only used in summer; they are fixed to iron rods over the skylight. Substitutes for awnings are ground-glass in the skylight, white muslin curtains over the dark ones (*see* Atelier), or a coat of thick starch paste on the glass of the skylight. The starch paste may be removed again with warm water.

Ba. The chemical symbol of Barium.

Back Focus is the distance between the ground-glass and the back lens of a compound objective, when the latter is focussed on a very distant object. The back focus is shorter than the equivalent focus (*see* Focus).

Background, Toned. A background which is gradu-

ally toned from black or gray to white. In order to make it, we cut into black or dark-gray pasteboard an opening corresponding somewhat with the figure. We obtain in this manner a mask, which is placed in the printing-frame, over the figure of which the background is to be toned. The further the mask is removed from the negative plate, the broader and softer will be the toning. For busts, an elliptical mask of suitable size will be sufficient.

Backgrounds for Portraits. We have flat, round, and hollow backgrounds. The flat ones are most generally used. Size for standing figures, 7 feet wide and 8 feet high. On the importance and effect of backgrounds, see Vogel's *Handbook*, pp. 302–313.

Bath. A vessel of glass for dipping the plates into. The transverse section should be oval, in order that the collodion film may not come in contact with the sides of the bath. When a great many plates have to be sensitized, a large bath, containing a great deal of solution, is preferable.

A narrow bath for plates 7 inches wide requires, when filled to a height of 6 inches, 500 to 600 cubic centimetres of solution ; a bath 10 inches wide, when filled to a height of $9\frac{1}{2}$ inches, will hold 1250 cubic centimetres ; a bath 14×16 will hold $3\frac{1}{2}$ litres of solution.

Br. Chemical symbol of Bromine.

Bristol Board. Strong white or colored pasteboard, for mounting pictures, either sized or unsized. Many boards contain hyposulphite of soda, owing to their manufacture. The presence of this substance is detected by treating the boards with blue iodine starch, which is discolored by it (*see* Iodine Starch).

Bromide of Ammonium. NH_4Br. Equivalent weight, 98. A white permanent salt, which dissolves readily in alcohol ; 100 parts of alcohol will dissolve 3 parts of bromide of ammonium.

Bromide of Cadmium. CdB+4HO. Equivalent, 171.7 Crystallizes in white needles; decomposes in the air by parting with its water of crystallization; readily soluble in water and alcohol; forms double salts with other bromides; very permanent.

Bromide of Potassium. KaBr. Crystallizes in cubes and is permanent, like KaI; it dissolves readily in water, but sparingly in alcohol (see Vogel's *Handbook*, p. 88).

Bromide of Silver. AgBr. Precipitates when we add to a solution of nitrate of silver bromine metal, and forms a yellowish-white precipitate, which is neither soluble in water nor in the nitrate bath; ammonium dissolves it sparingly, but the fixing bath very readily. Its presence in the iodide of silver collodion plate gives to the picture greater softness, *i. e.*, the plate becomes more sensitive to shadows and less sensitive to high lights (*see* Collodion).

Bromide of Sodium. NaBr+4HO. Equivalent, 139. Contains water; dissolves readily in water, sparingly in alcohol; very often it contains considerable impurities.

Bromine. Br. Atomic weight, 80. A brown, stinking liquid; boils at 63°; is poisonous; somewhat soluble in water, and readily combines with the metals.

Cabinet Size. Size of picture, 100 x 138 millimetres; size of mount, 115 x 163 millimetres. Objective for cabinet size, *see* Portrait Objectives.

Cadmium Salts (*see* Iodide of Cadmium and Bromide of Cadmium).

Camera Testing. The photographic camera should have the following properties:

1. It should be perfectly light tight. Test: Close the objective, remove the ground-glass, and place your head under the focussing-cloth until the eye has become accus-

tomed to the darkness. Holes and cracks will soon show themselves if there are any.

2. The camera must easily and regularly draw out and shut.

3. The plate in the plate-holder and the ground-glass must occupy exactly the same position. Test: Focus very sharply on the middle line of a printed paper, which is placed obliquely to the lens (a newspaper pasted on a board); the ground-glass is now removed, and the plate-holder inserted. We place a piece of ground-glass in the plate-holder, and if the latter is correct the same line of print should be in focus which appeared previously sharp on the ground-glass.

4. The objectives should admit of ready changing. It is best if every objective has its own front-board. Cameras for travelling should have an arrangement for raising and lowering the objective by merely moving the front-board to which it is fastened.

5. For a portrait camera it is further desirable that the back which carries the plate-holder should have a lateral motion (swing-back).

6. The camera should admit of being pushed together to beyond the back focus of the smallest objective which is used with it, as well as to admit of an extension of one and a half to two times the focal length of the largest objective adapted to the camera. Example: A carte de visite camera, intended for a tube of $4\frac{1}{2}$ inches focus (calculated from the back lens), should allow of being pushed together to 4 inches, while at the same time the bellows should admit of an extension of 9 inches. If the same camera is intended also for a tube of 7 inches focus, the scope of the bellows should reach $10\frac{1}{2}$ inches. Cameras intended for copying require an extension amounting to three times the focal length of the lenses used.

7. The camera should be made of perfectly dry and thoroughly seasoned wood which will not warp.

8. All the interior parts should be blackened. Lampblack mixed with a diluted shellac solution is used for this purpose, and applied with a brush.

Carbonate of Ammonia or hartshorn salt consists of a mixture of carbonate and bicarbonate of ammonia. The former by evaporation is decomposed into carbonic acid and ammonia. On this is based its employment as a fumigating agent for ammonia paper and ordinary silver paper (fuming in the printing-frame) as proposed by the author. Exposed to the air, the effect of ammonia is lost by evaporation. It should be kept, therefore, in closed bottles.

Carbon Pictures (*see* Pigment Pictures).

Carton Durci is Bristol board made water-tight by means of asphaltum. It is used for dishes, &c. (*See* Asphaltum Dishes.)

Chemical Focus (*see* Difference of Focus).

Children's Pictures, Lenses for. These have a very large opening with a very short focus. They work very rapidly, but the picture is curved. They are not suitable for standing pictures, and are very expensive.

Examples.—Dallmeyer 2 C, $2\frac{1}{4}$ inch opening, $4\frac{1}{2}$ inches back focus. Works twice as rapidly as card lens 2 B.

Voigtlander rapid-working lens, No. 4, 3 inches opening, $8\frac{1}{4}$ inches equivalent focus. Works a little more rapidly than the carte de visite lens D.

Busch rapid lens, System 3,

3 inch opening, relative opening $\frac{1}{3}$.
3 " " " " $\frac{1}{2.5}$.

Hermagis recommends his rapid worker No. 7. (*See* Portrait Lenses.)

The Ross quick-acting lenses, for cartes and cabinet size, are much sold in America.

Loescher & Petsch use for children's pictures the or-

dinary card lens (Dallmeyer 2 B), but only take these pictures when the weather is favorable.

The chemicals are the same as those used for instantaneous pictures.

The best mode of operating is for one person to attract the attention of the child while another one watches the most favorable opportunity. The pose, so far as it is necessary, is only given after the plate is in the plate-holder. About sensitive plates for children's pictures, *see* Instantaneous Pictures.

Chloride of Lime Toning Bath (*see* Toning Baths).

Chloride of Gold (*see* Gold).

Chloride of Silver. Formula, AgCl. Consists of 108 parts of silver and 35.5 chlorine. Is insoluble in water, alcohol, and ether, soluble in ammonia, cyanide of potassium, hyposulphite of soda, and the sulphocyanides. The action of light changes it into subchloride of silver, Ag_2Cl. The presence of organic matter and light reduces it to metallic silver of various hues, as violet, brown, gray. It is formed by placing substances containing chlorine metal (such as chlorine collodion or positive paper) into the nitrate bath; also by adding common salt to the solution of nitrate of silver, residues, &c., for the purpose of recovering the silver.

Chromate of Ammonia (*see* Ammonia, Bichromate of).

Chromate of Potash (*see* Potassium, Chromate of).

Chromatic Aberration. The errors of the lenses which are produced by the different refrangibility of the colors.

Cleaning Plates for Negatives. The best way is to wash the plates with water; dry them with a clean towel; rub them with a few drops of ammonia, and polish with a clean linen pad.

Collodion. *Plain Collodion.*—We dissolve 2 parts of gun-cotton, or, better, papyroxylin, in 50 parts of de-

odorized alcohol of 95° and 50 parts of ether. The alcohol is first poured over the cotton and left to soak it for a few minutes; the ether is added next, and the mixture is now well shaken. This yields a collodion containing 2 per cent. of cotton. When we desire a collodion containing 4 per cent., we double the quantity of cotton.

The cotton itself should react neutral. For testing it, it is placed on fine litmus-paper and moistened with a drop of water; the cotton is then pressed against the paper. If the paper is reddened the cotton is acid. Acid cotton should previously be washed in ammonia; 1 part of ammonia is diluted with 4 parts of water, the cotton is placed into it for fifteen minutes, the moisture is pressed out, and the cotton is dried by placing it on a metal dish over a pot with boiling water. Powdery cotton, such as falls to pieces when touching it, requires more ether than strong fibrous cotton, as otherwise the film will be too tender (rotten).

For the former kind we should take

Alcohol, ...	40 parts.
Ether, ...	60 "

In summer or in hot climates the quantity of ether should be lessened, while in winter or in cold climates it should be increased.

Plain collodion should be left to settle for at least ten days, when the clear part is decanted. With fibrous, tough pyroxylin the settlement is considerable.

Filtering is not to be recommended.

Plain collodion should be kept in a dark, cool place. Shaking it with chemically pure anhydrous carbonate of ammonia should not color it brown within two hours.

Collodion for Dry Plates is best made from powdery gun-cotton, which has been prepared at a high temperature.

Collodio-Bromide Dry Plates. Invented by Lea; improved by Wortley.

Collodion.—

Pyroxylin,	(short-fibred, made at a high temperature,) .	2 grammes.
Alcohol, ...		48 "
Ether, ...		48 "

The mixture is left to settle.

Sensitizer.—

Collodion, ...	40 grammes.
Ether, ...	52 "
Bromide of Cadmium solution, .	9 "

($12\frac{1}{2}$ parts of bromide of cadmium to 80 parts of alcohol, and filtered.)

Acidifier.—2 parts muriatic acid, 1 part nitric acid, of 1.4 specific gravity; these are mixed and placed in hot water until the fluid has turned yellow; 9 drops of this mixture are added to 200 grammes of collodion. (The acid collodion keeps.)

Silvering.—1 gramme of powdered nitrate of silver is boiled with 11 grammes of alcohol, and is gradually added to 31 grammes of collodion, shaking it all the time. This must be done in the dark.

Collodionizing.—The plates are albumenized (see above); the silvered collodion is next poured on the plates, and as soon as it has settled, the plate is washed under a spiggot until the greasy lines have disappeared; they are next dipped into the following solution:

30 grammes of a solution of gum arabic (10 parts of gum arabic, 10 parts of sugar, 80 parts of water, a few drops of carbolic acid).
150 grammes of water.
20 drops of pyrogallic solution (10 parts of pyrogallic acid, 80 parts of alcohol).

The plate remains in this bath for one minute; it is then taken out and left to dry.

Exposure.—Two to four times as long as with wet plates.

Development.—1 gramme of pyrogallic solution, (1 : 8)—see above—to 80 grammes of water. The plate is placed into this, and afterwards 25 drops of a solution of carbonate of ammonia are added (1 : 8) and also 5 drops of bromide of ammonia solution (1 : 8).

Intensifying and Fixing as usual.

Consumption of Materials.—Silvered collodion, 12 cubic centimetres for one-tenth of a square metre; collodion for a carte de visite plate about 3 cubic centimetres (*see also below*, Uranium Collodion Process).

Collodio-Chloride of Silver Paper (*see* Collodio-Chloride of Silver).

Collodio-Chloride of Silver. Invented by Simpson; is used for making positives and also pictures on opal glass (porcelain pictures).

1. Formula after Monckhoven:

a. Pyroxylin, ... 1 gramme.
Ether, ... 40 cubic centimetres.
Transparent Alcohol, . . . 40 " "
Left to settle.

b. Chloride of Magnesium, . . 1 gramme.
Alcohol, ... 10 cubic centimetres.
To be filtered.

c. Nitrate of Silver, 20 grammes, dissolved in
Water, . . 30 cubic centims., to which is added
Alcohol, . . 70 " "
To be filtered.

d. Citric Acid, Powdered, 18 grammes, dissolved in
Boiling Water, . . 18 cubic centims., to which is added
Alcohol, . . . 162 cubic centimetres.
To be filtered.

600 cubic centimetres of solution *a* are poured into a bottle of yellow glass; 50 cubic centimetres of *b* are added and well shaken; next, 60 cubic centimetres of *c* are poured in and shaken for five minutes; finally 40 cubic centimetres of solution *d* are added, and the whole is left for eight to ten days, when it is fit for use.

The glass plates are first albumenized (see this article), and next coated with the collodio-chloride of silver; when dry, they are fumed with ammonia for fifteen minutes, and printed in the printing-frame. The printing should be a little darker than on paper, and the picture is toned in an ordinary but rather diluted gold toning bath. Fixing as usual (*see* Vogel's *Handbook*, page 187).

2. Formula after Krippendorff. The following solutions are made:

I. 2 grammes of nitrate of silver in 2 grammes of distilled water.

II. ½ gramme of chloride of calcium in 8 grammes = 10 cubic centimetres of alcohol.

III. ½ gramme of citric acid in 8 grammes of alcohol.

36 drops of Solution I are mixed with 34 grammes of hot alcohol, and 1.5 to 2 grammes of gun-cotton are added.

After shaking it repeatedly, 36 cubic centimetres of hot ether are added, and the compound is shaken until the solution is complete. Before the collodion has become cold, 4.5 cubic centimetres of Solution II, and finally, 4.5 cubic centimetres of Solution III are added, in the dark, taking care to shake the solution for fifteen minutes. The collodion is kept in a dark place and keeps well. It should be shaken every eight to ten days.

Take a quarter-sheet of smooth cartoon-paper, bend the corners in such a manner as to form a dish, and pour

the collodion into it; for every 3 square centimetres of surface about 1 cubic centimetre of collodion will be required. The excess of collodion should be collected in a separate bottle, and not be used again until it has settled for twenty-four hours. Instead of the heavy cartoon-paper the chalk-paper of the lithographers, and ordinary gelatinized writing-paper may be used. The paper is stretched on a board with pins, and left to dry. Printing is carried on until the deepest shadows appear bronzed. After exposure the picture is trimmed to the suitable size, according to lead-pencil lines which have been drawn on the back of it. The print is washed thoroughly in ordinary water, renewing the same every two or three minutes, as otherwise the picture will turn yellow; and when the water remains clear (in about half an hour) the washing should be stopped.

For toning and fixing the following three solutions are required:

I. 40 grammes of hyposulphite of soda in 115 grammes of distilled water, dissolved in a dish.
II. 2.5 grammes of acetate of soda in 55 grammes of distilled water.
III. 1 gramme of chloride of gold in 50 grammes of distilled water.

$2\frac{1}{4}$ cubic centimetres of Solution III are added to Solution I, next Solution II is added to I, and the pictures are placed in it; they will at first turn yellow, next brown, then purple-red, and finally black. After thirty minutes this operation is completed. The pictures are drawn separately through clean water and placed in a dish full of water. With chalk-paper the film will detach itself without any aid. With gelatinized paper the film will also separate of its own accord, but warm water should be used and a tin vessel. The paper should

be removed and the water renewed. When chalk-paper has been used the film should be placed with its front-side on a glass-plate, and the chalk which adheres to the back should be removed with a hair-pencil or with a little cotton. If the film does not separate at all (with old paper), then the print should be washed again very thoroughly and dried; the pictures remaining on the original paper.

The film is floated on a glass-plate, and lifted out of the water; it is coated with a gelatin solution 1 : 50, and a piece of chalk-paper cut to size is pressed on to it. If on lifting a corner of the paper the film adheres to it, the paper should be taken up. To prevent the easy tearing of the film, the collodion may be coated with positive varnish.

Collodion, Faults of (*see* Negative Process, Failures in).

Collodion Iodizers. For the wet process the collodion is iodized with iodine and bromine salts; the former gives to the pictures the intensity; on the latter the sensitiveness to feeble light depends. (Vogel's *Handbook*, page 93.)

The salts used for iodizing should be soluble in alcohol and ether; they should keep and react neutral. Salts of cadmium thicken the collodion; alkaline salts make it thinner. Too little salt in the collodion produces veiled and insensitive plates, while if the quantity is too great, streaks will result.

With a collodion containing $1\frac{1}{2}$ per cent. of cotton, not more than 2.2 per cent. of cadmium salts should be taken, nor less than $1\frac{1}{4}$ per cent. Cadmium salts are the easiest dissolved, while the potassium salts dissolve with the greatest difficulty. The least stable are the ammonium and lithium salts. Collodion sensitized with the latter

should be used at once. Cadmium collodion keeps for years, but it ripens slower.

The iodizing salt should not be dissolved in plain collodion but in alcohol; the solution should be filtered and the filtrate added to the plain collodion.

Generally the following proportion is taken: for 3 to 4 parts of an iodine compound 1 part of a bromine salt; but it should be observed that 14 parts of iodide of ammonium contain as much iodine as 16 parts of iodide of potassium, or 18 parts of iodide of sodium. If, therefore, we wish to substitute one iodine or bromine salt for another in a given formula, we have to do it according to the chemical equivalents (see table of same), for instance:

166 parts of dry Iodide of Potassium are equal to
186 " " " " Sodium, or
145 " " " " Ammonium, or
134 " " " " Lithium (anhydrous).

119 parts of Bromide of Potassium are equal to
139 " " " " Sodium, or
98 " " " " Ammonium,
172 " " " " Cadmium.
(See Vogel's *Handbook*, p. 88.)

This proportion refers only to chemically pure salt; for the iodizing salt of commerce the proportion is somewhat different. For instance, 10 parts of bromide of cadmium correspond with 6 parts of bromide of ammonium, 6.8 bromide of lithium, 9.3 iodide of ammonium.

Formulæ.—We will give only a few of the most important, which have been recommended by the Society for the Promotion of Photography in Berlin.

Sodium collodion according to Dr. Vogel:

Iodide of Cadmium,	1 gramme.
" " Sodium,	0.4 "
Bromide of Sodium,	0.3 "

Dissolved in 30 cubic centimetres of alcohol, filtered, and 1 part by volume mixed with 3 parts by volume of plain collodion of the following formula:

Alcohol,	50 parts.
Ether,	50 "
Cotton,	2 "

Equivalent collodion of Dr. Vogel:

18 grammes of Iodide of Cadmium dissolved in 270 of Alcohol.
17 grammes of Bromide of " " " 270 "

Each filtered by itself, and 4 parts by volume of the solution of the iodine salt are mixed with 1 part by volume of the solution of the bromine salt, and 15 parts of plain collodion should contain 2 per cent. of cotton.

Petsch collodion:

Gun-cotton,	34 grammes.
Ether,	1560 "
Alcohol,	780 "

To which is added:

Iodide of Ammonium,	16 grammes.
Bromide of Cadmium,	16 "
Iodide of Potassium,	16 "
" " Cadmium,	6.6 "

Previously dissolved in 780 parts of alcohol, and filtered.

Elbert Anderson's collodion:

Ether, ...	240 grammes.
Alcohol, ...	240 "
Iodide of Ammonium, . . .	4 "
" " Cadmium, . . .	2 "
Bromide of Potassium, . . .	2 "

The amount of gun-cotton is not stated, but, according to the rules above stated, 6 grammes should be sufficient. It is advisable to dissolve the salts in a portion of the alcohol, to filter, and to add to the plain collodion.

Every collodion should be left for a few days to ripen. Anderson's collodion for 1 to 2 days. Vogel's, 2 to 3 days. The sensitiveness, intensity, and permanence of collodion depend in a great measure on the quality of the gun-cotton, and vary considerably.

Collodion which has turned red may be discolored again by placing a strip of zinc into it; but such a collodion is apt to give veils, and is not as serviceable as a fresh one. It is better to precipitate the cotton by the addition of water.

Collodion, Iodized, Specific Weight of. Collodion which contains 2 gun-cotton, 85 alcohol, 85 ether (1CdI, 1CdBr), has a specific weight of 0.79.

Collodion, Consumption of. In coating a plate, the consumption depends on the manner of pouring it out and on the consistency of the collodion. Of Dr. Vogel's collodion, the author uses, when coating it heavy, on 1 sq. foot $= \frac{1}{10}$ sq. metre, $16\frac{2}{3}$ grammes $= 20$ cubic centimetres; when coating it lightly, on 1 sq. foot $= 11.4$ grammes.

For carte de visite plates, we require $3\frac{2}{3}$ cubic centimetres $= 3$ grammes, provided we pour the collodion very thin. One cubic centimetre of this collodion weighs 0.81 gramme.

Of ethereal collodion (dry plates) the author uses on 1 sq. foot = $\frac{1}{10}$ sq. metre only 11.7 cubic centimetres.

Consumption of Chemicals in the Negative Process per square foot = $\frac{1}{10}$ square metre of plate for landscapes.

1. Equivalent collodion. Cadmium iodized, containing $1\frac{1}{2}$ pyroxylin, $1\frac{1}{2}$ per cent. salt.

I use per square foot = $\frac{1}{10}$ square metre $16\frac{2}{3}$ grammes = 20 cubic centimetres = $\frac{1}{2}$ an ounce.

One of my scholars consumes only 11.4 grammes, or only 3 grammes for a plate of card size.

2. Silver bath—1 to 10 and 1 to $12\frac{1}{2}$. The consumption of the bath solution per square foot is at most but $\frac{1}{4}$ of an ounce. This includes the loss by filtration, emptying dishes, &c.

According to Meikes, one of my former assistant experimenters, the consumption was $\frac{1}{2}$ ounce = $16\frac{2}{3}$ grammes per square foot = $\frac{1}{10}$ square metre.

Silver bath for filling a flat dish 8 to 10 inches with as much solution as is necessary for sensitizing conveniently = 400 cubic centimetres = 13 ounces.

3. Developer and intensifier (5 per cent. protosulphate of iron or 7 per cent. sulphate of iron and ammonia, 3 to 4 glacial acetic acid and alcohol).

Consumption per square foot = 300 cubic centimetres inclusive of intensifier (I intensify with iron); without other intensification, 200 cubic centimetres = 7 ounces were consumed.

Of solution of citric acid and nitrate of silver (2 per cent. silver and 2 per cent. citric acid) the consumption amounted to 48 cubic centimetres = $1\frac{1}{2}$ ounces per square foot.

4. Water for washing after the development and intensification per square foot, 2 litres = $3\frac{1}{2}$ pints.

5. Fixing solution, cyanide of potassium, 1 to 25 per square foot, 100 to 150 cubic centimetres = 50 ounces.

With a more diluted solution, 180 to 200 cubic centimetres = 7 ounces.

6. Water for washing after fixing, per square foot, about 17 pints.

7. Varnish, per square foot, 7½ cubic centimetres = 2 drachms.

8. Albumen solution for preparing plates (the white of 1 egg, to which is added 10 cubic centimetres of ammonia and 5 drops of carbolic acid, well shaken); 8 cubic centimetres of this are diluted with 100 cubic centimetres of water. Of albumen solution I use 25 cubic centimetres = 6 drachms per square foot.

The consumption of chemicals for portraits must be nearly the same.

For reproductions and similar work, the consumption of developer and intensifier is greater.

Consumption of Hypo per sheet, 4 to 5 grammes = 70 grains.

Consumption of Intensifier (*see* Consumption of Chemicals).

Consumption of Nitrate of Silver in the Positive Process is, according to Nickel, $\frac{1}{14}$ of an ounce per sheet of albumen paper; according to Meicke (Vogel's *Handbook*, page 136) = 33 grains per sheet when the bath is old, and 40 grains per sheet when the bath is fresh.

Consumption of Salt of Gold in Toning is, according to Davanne, ½ grain per sheet. In making toning solutions, 1 grain per sheet should be calculated upon.

Copal Varnish. Copal dissolves only in alcohol when ether is present; easier in benzine, combined with other resins; it is but seldom used as a varnish for negatives.

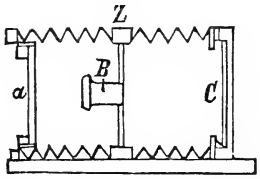
Nazel recommends—

Dammar Gum, ...	2 parts.
Copal, ...	1 part.

The resins are melted in a dish, and afterwards dissolved in benzine, the quantity of which must depend on the consistency.

Copying Camera is used for making positives from negatives by means of the collodion process. The best camera for this purpose is one with very long bellows and an intermediate piece, *Z*.

Fig. 3.



The negative is placed at *a*, the objective is placed at *B*, and the plate-holder at *C*. A pasteboard box is placed in front of *a* in order to receive the light nearly vertical and to exclude side-light. With such an arrangement, the objective is protected against all extraneous light, which is an important point with such reproductions, as by it fog and veil will be avoided. In default of such a copying camera, two cameras are placed end to end together, and in the front one the negative is placed at the spot generally occupied by the ground-glass. (See Vogel's *Handbook*, page 196.)

Copying of Drawings, Paintings, &c. (*see* Reproductions).

Cotton (*see* Pyroxylin).

Cracks in the Negative Pictures are often caused by

keeping the plate for a long time in a damp place. There are two kinds of cracks, very fine ones called *hair lines*, and others called mole lines, which are elevations of the film. The former are recognized by looking through the negative, the latter by looking over the surface. Hair lines are removed by rubbing lampblack over the negative with the soft part of the finger. To prevent the recracking of such restored plates, they should be brushed over with a solution of gum 1 : 40, employing for the purpose a half dry brush, which has been dipped in the gum and squeezed out. Mole lines are removed by vapor of alcohol. The alcohol is poured in a dish, and the negative, varnished side downwards, is placed over it, and left for twelve hours.

Curvature of the Picture is the deviation of the field of the picture from the plane; it gives to the margin of the picture the appearance of not being sharp, when we have focussed for the centre, and *vice versâ*. (See Vogel's *Handbook*, page 57.)

Cyanide of Potassium. KCy, poisonous; dissolves readily in water; it is used for fixing negatives. Solution, 1 : 25; consumption, 100 to 150 cubic centimetres of solution for a square foot of plate = $\frac{1}{10}$ square metre. It is also used for removing the silver stains from the hands. Great care is necessary that the cyanide does not come in contact with a cut, as paralysis may result from it. Should, however, the cyanide come in contact with a fresh cut or wound, the antidote, solution of sulphate of iron (developer), should be applied at once. With internal poisoning by means of cyanide of potassium, the solution of sulphate of iron is also an antidote.

Dark-Room. Requirements of the same: 1. Space; 2. Very good ventilation; 3. To be well heated in the

winter; 4. To be kept cool in the summer; 5. Water supply.

Contents: One table for coating plates and sensitizing paper; one table for fixing and developing; a stand for drying plates; shelves for chemicals; several boxes with plates. The dark-room should be lighted by lamps. If gas is used, the brightness should be moderated by green or yellow screens; if daylight is used, care should be exercised in selecting the yellow window glass. It should be tested in the following manner: the glass is placed in front of a camera without an objective; a sensitized plate is placed in the plate-holder, and the shutter of the latter is half drawn out; the plate is exposed in this manner for five minutes, and developed. The plate should not show any fogginess. In case a single thickness of glass is insufficient, two or three plates should be used (*see* Gallery).

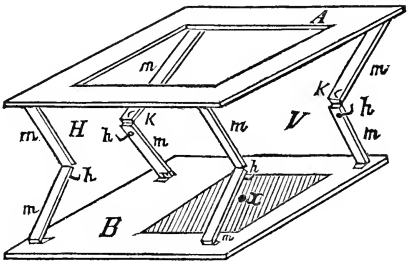
Dark-Tent. The tent should have a surface-table equal to four times the surface of the plate which is to be prepared therein. It should be so constructed that it may be easily put up or taken down, and it should be optically (not chemically) well lighted. The windows are best made of four thicknesses of Parisian oiled silk; the margins should be thicker, double black English satin.

The tent represented in the annexed figure is the invention of the author; it consists of a folding wooden frame with a plate B, which serves as a work-table, and an open top-piece A, which is covered with black cloth. The table and top-piece are connected by the hinged folding pieces *m m*. When the hooks *h h*, which fit into the eyes K K, are unfastened, the supports *m m* fold like a pocket-knife, and the frame lies perfectly flat.

Inside of this wooden frame the four-cornered tent-cloth is fastened. It is nailed to the top-piece A and the

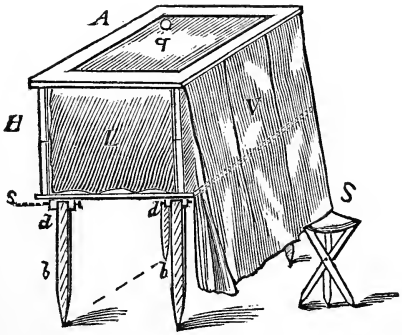
table B; at H, Fig. 4, is the window of oiled silk; at V, Fig. 5, is the front curtain, through which the operator has to creep and seat himself on the camp-stool S.

Fig. 4.



At *q*, Fig. 5, is an opening for ventilation; at *x* is a large opening in the table, which is lined with caoutchouc

Fig. 5.



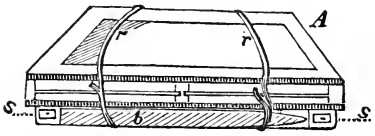
cloth, and forms a kind of dish; it serves to receive the developing solution as it flows off the plate; through a

hole in the centre the waste solution is discharged, and india-rubber hose is not absolutely necessary.

The tent is placed on four legs, *b b b b* (Fig. 5). These are either screwed on, or they are fixed with hinges, and fold under the table; binding screws, S S, serve to fasten the legs in position when the tent is erected.

When we desire to fold the tent, the curtain V is first pushed inward; the camp-stool is placed inside (also the feet if these should be arranged for unscrewing); the hooks *h h h h* are next undone, and the top-piece A is lowered. The tent-cloth has ample room between the supports *m m m m*, and is protected by them; the feet are folded, and the whole is strapped together by the

FIG. 6.



straps *r r* (Fig. 6). The straps serve also to carry the tent, and it may be carried on the back like a knapsack.

Size of the plate B, 30 x 40 inches. Weight, 18 pounds. Time necessary to erect it, seventy-five seconds.

Depth is the faculty of a lens to form an image of equal sharpness of objects which are removed from the lens at unequal distances; depth decreases when the opening and the focus are increased. The images of objects which are removed from the lens more than fifty times the length of the focus, lie in the same plane.

Developer, Acid, and development is, for wet plates, a solution of sulphate of iron. Conditions of its action are: 1. The presence of a silver solution on the plate; 2. A certain proportion of alcohol and acetic acid, in order

to facilitate the flow of the developer, and to enter into the film. Thin iodized collodion can stand but a small proportion of iron (2 per cent.). Thick iodized collodion requires a strong developer. Strong developers give more details in the shadows (they work softer), while weak developers work hard. The latter are better suited for copying line drawings, &c.

Formulæ for portrait and landscape work:

5 parts of Sulphate of Iron, or 7 parts of Sulphate of Iron and Ammonia.
3 to 4 parts of Glacial Acetic Acid.
100 parts of Water.

Or,

10 parts of Sulphate of Iron, or 14 parts of Sulphate of Iron and Ammonia.
3 to 5 parts of Alcohol.
200 parts of Water.
2 drops of Sulphuric Acid.

For drawings:

5 parts of Sulphate of Iron, or 7 parts of Sulphate of Iron and Ammonia.
3 to 5 parts of Alcohol.
200 parts of Water.
1 drop of Sulphuric Acid.

The proportions of alcohol, as well as of glacial acetic acid, should be greater with a bath containing much alcohol than with one freshly made.

It is very convenient to keep in stock a saturated solution of sulphate of iron, or a solution of 1 part of iron to 5 parts of water. This may be diluted in due proportions, and the alcohol and glacial acetic acid added afterwards. Sulphuric acid may be added to the saturated

solution at once; to every 100 grammes of iron about 1 cubic centimetre of sulphuric acid.

Ordinary spring-water is suitable for making the developer. (Water, which is too hard, requires a little more of glacial acetic acid.) Ordinary alcohol is sufficiently pure for developing purposes, but it should not contain too much fusel oil. The above-mentioned developer, when mixed with citrate of silver solution, will also answer for intensifying.

Developer for Dry Plates (*see* Dry Plates).

Gelatin Developer (*see* Gelatin).

Developer, Alkaline (*see* Collodio-Bromide and Dry Plates).

Developer. Consumption of per square foot = $\frac{1}{10}$ square metre, about 300 cubic centimetres; per carte de visite, about 75 to 100 cubic centimetres.

Developer, Faults of (*see* Negative Process, Failures of).

Dextrine recommends itself for preserving negatives. 1 part of yellow (not white) dextrine is dissolved in 8 parts of water, and the solution is poured on the moist negative. The addition of ammonia will make the dextrine solution keep. If it is desired to retouch the plate with lead-pencil before varnishing it, a solution of the strength of 1 : 5 to 1 : 6 should be employed. The plate is afterwards coated with ordinary negative varnish. Otherwise, a diluted varnish should be used, as it offers a better surface for the retouch.

Diaphragm (*see* Stops).

Diapositives or transparencies are made as follows:

1. In the camera, by using a negative as the original, and taking a picture of it by letting the light pass through the negative. The negative is placed in a plate-holder, and this again in a camera; the camera is placed with its open end against another camera provided with ob-

jective and sensitized plate. The whole system is directed towards the sky, the negative being protected by a plate of ground-glass (see Copying Camera, Fig. 3). A collodion colored yellow with iodine should be used for making positives; the nitrate bath should be acid, and for the developer 2 per cent. of iron and 3 per cent. of glacial acetic acid should be used. Intensifying is not necessary. After fixing, the pictures are toned with an acid solution of chloride of gold, 1 part gold salt to 1000 parts of water. (Vogel's *Handbook*, page 196.)

2. By printing directly on dry plates or collodio-chloride of silver (see this article), or also albumen (*see* Albumen Negative and Positive).

Dippers for dipping the plate into the silver bath are best made of silver wire or ebonite. Dippers of gutta percha we do not recommend (*see* Gutta Percha).

Dishes are used for sensitizing, washing, toning, and fixing pictures and plates. They are made of glass (which offers the most resistance) or porcelain and earthenware (these very often lose the glazing), of gutta percha and asphalted wood. The latter are not so easily broken, and are just as good for sensitizing paper as glass, but the solutions should not remain in them too long.

Distortion. A fault of the lens. It has the effect of making straight lines appear curved. This fault occurs in single landscape lenses, orthoscopic lenses, and in some portrait objectives. Triplets, aplanatic, globe, and pantascopic lenses are generally free from it. (Vogel's *Handbook*, page 57.)

Doublet Lenses of Ross, for views and copying,—small, ordinary, and wide-angle.

Dragon's Blood for Coating Negatives. One part dragon's blood dissolved in 100 parts of negative varnish; the varnish bleaches in the light. It is better to use *iodine varnish* (which see).

Dry Plates. Harnecker's dry plates are made in a very simple manner, by sensitizing and washing plates prepared with Harnecker's resinous dry-plate collodion. (*See* Albumen Process, Collodio-Bromide Dry Plates, Tannin Process, Tea Process, &c.)

Exposure.—Twice to three times as long as for wet.

Development.—The plate is dipped into distilled water, and afterwards in a negative bath; the following solution is then poured over it:

Sulphate of Iron, ...	1 part.
Water, ...	220 parts.
Glacial Acetic Acid, . . .	3 "
Alcohol, ...	4–5 "

Intensifying and fixing as usual. (Vogel's *Handbook*, page 184.)

Dry Plates, Morphia. Coat with a good bromo-iodized collodion, sensitize for three minutes in a good negative bath, wash first with distilled and afterwards with ordinary water, immerse for one minute in the following cold solution:

Acetate of Morphia,	1 gramme (15 grains).
Water, . . .	500 grammes (17 ounces).

The plate is now left to dry.

Exposure.—With fresh plates, twice as long as wet.

Development.—

Pyrogallic Acid, ...	1 part.
Water, ...	200 parts.

The picture appears pale. It is strengthened by the addition of a few drops of citrate of silver.

Further intensification and fixing as usual.

Dry Plates, Tea Process. *Tea Process of Newton.*—A large tablespoonful of Japanese tea mixed with 8 ounces of boiling water; pour the liquor off; add 2 ounces

of water, also ½ ounce of pulverized milk sugar; dissolve and filter. This solution keeps several weeks.

Sensitize the plate, wash in two dishes with melted ice, then under the tap, and put them into a dish with the tea solution one or two minutes. Set aside to dry.

DEVELOPER No. 1.

Hot Water,	5 ounces.
Gallic Acid,	30 grains.
Pyrogallic Acid,	30 "
Citric Acid,	30 "
Glacial Acetic Acid,	30 drops.
Saturated Solution of Acetate of Lead,	10 "

DEVELOPER No. 2.

Gelatin,	20 grains.
Double Sulphate of Iron and Ammonia,	80 "
Sulphate of Iron,	80 "

Soak the gelatin fifteen minutes in cold water; pour on 10 ounces of boiling water, add the iron salts, and forty drops of glacial acetic acid; then 20 grains of tartaric acid. Let it remain for two weeks before using it.

Exposure.—Five or six times that of a wet plate.

Development.—A ten-grain solution of nitrate of silver with 5 drops of glacial acetic acid. Moisten the plate; flow sufficient Developer No. 1 over it for thirty to sixty seconds; let flow in a cup; add two or three drops of the silver solution; pour it immediately back over the plate.

The picture develops soon. If it has all appeared, treat it in the same way with Developer No. 2 mixed with silver. If the action ceases, apply the Developer No. 1 again. Do not get too great intensity.

Enlargement. *a.* Direct, consists in copying on silvered paper without development, by the aid of sunlight.

b. With development (*see* Whey Process).

a. Is recommended for direct sunlight.

b. Is recommended for feeble light, or artificial light.

The most practical enlarging apparatus is Roettger's (see Vogel's *Handbook*, page 201).

c. In the camera by the collodion process. An enlarged positive is made from the negative (*see* Copying Camera). From the positive an enlarged negative is taken. A careful retouching of the original negative is important, as also the retouching of the first positive and the second negative; the exposure also should be timed very carefully. The last negative is printed as usual.

In order to obtain very clear positives it is advisable to acidulate the collodion (4 drops of nitric acid to 4 ounces of collodion). The acid collodion does not keep long, it should, therefore, be used at once.

Monckhoven takes first a transparency from the original negative on collodio-chloride of silver (which see), and enlarges this picture in the camera.

The following table gives the distance of the object for an enlargement of from 1 to 15 times; also the distance of the ground-glass from the optical centre of the objective. With a double objective this centre lies in the plane of the stop. It is necessary to know the equivalent focus (which see). The numbers in the upper horizontal line give the desired enlargements; the two figures of the other horizontal lines give the distances of the original and the ground-glass from the objective.

For instance, for a lens of 4 inches focus (see fourth horizontal line), we must, in order to get an enlargement of 8 times (see eighth vertical column), place the original 4½ inches from the optical centre of the lens (stop), and the camera must be drawn out 36 inches.

If we desire a diminished picture the same figure will answer, but reversed, *i. e.*, the smaller one for the ground-glass, the larger one for the original or model.

TABLE OF ENLARGEMENTS.

Equivalent Focus of the Lens.	Distance for Enlargement or Diminution.										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**15**
In. 2	In. 4 4	In. 6 3	In. 8 $2\frac{3}{4}$	In. 10 $2\frac{1}{2}$	In. 12 $2\frac{2}{5}$	In. 14 $2\frac{1}{3}$	In. 16 $2\frac{2}{7}$	In. 18 $2\frac{1}{4}$	In. 20 $2\frac{2}{9}$	In. 22 2.2	In. 32 $2\frac{2}{15}$
$2\frac{1}{2}$	5 5	$7\frac{1}{2}$ $3\frac{3}{4}$	10 $3\frac{1}{3}$	$12\frac{1}{2}$ $3\frac{1}{8}$	15 3	$17\frac{1}{2}$ $2\frac{11}{12}$	20 $2\frac{6}{7}$	$22\frac{1}{2}$ $2\frac{13}{16}$	25 $2\frac{7}{9}$	$27\frac{1}{2}$ $2\frac{3}{4}$	40 $2\frac{2}{3}$
3	6 6	9 $4\frac{1}{2}$	12 4	15 $3\frac{3}{4}$	18 $3\frac{3}{5}$	21 $3\frac{1}{2}$	24 $3\frac{3}{7}$	27 $3\frac{2}{8}$	30 $3\frac{1}{3}$	33 3.3	48 $3\frac{1}{5}$
$3\frac{1}{2}$	7 7	$10\frac{1}{2}$ $5\frac{1}{4}$	14 $4\frac{2}{3}$	$17\frac{1}{2}$ $4\frac{3}{4}$	21 $4\frac{1}{5}$	$24\frac{1}{2}$ $4\frac{1}{12}$	28 4	$31\frac{1}{2}$ $3\frac{15}{16}$	35 $3\frac{8}{9}$	38 3.8	56 $3\frac{2}{3}$
4	8 8	12 6	16 $5\frac{1}{4}$	20 5	24 $4\frac{4}{5}$	28 $4\frac{2}{3}$	32 $4\frac{4}{7}$	36 $4\frac{1}{2}$	40 $4\frac{4}{9}$	44 4.4	64 $4\frac{4}{15}$
$4\frac{1}{2}$	9 9	$13\frac{1}{2}$ $6\frac{3}{4}$	18 6	$22\frac{1}{2}$ $5\frac{5}{8}$	27 $5\frac{2}{5}$	$31\frac{1}{2}$ $5\frac{1}{4}$	36 $5\frac{1}{7}$	$40\frac{1}{2}$ $5\frac{1}{16}$			
5	10 10	15 $7\frac{1}{2}$	20 $6\frac{2}{3}$	25 $6\frac{1}{4}$	30 6	35 $5\frac{5}{8}$	40 $5\frac{5}{7}$	45 $5\frac{5}{8}$	50 $5\frac{5}{9}$	55 5.5	80 $5\frac{1}{8}$
$5\frac{1}{2}$	11 11	$16\frac{1}{2}$ $8\frac{1}{4}$	22 $7\frac{1}{8}$	$27\frac{1}{2}$ $6\frac{7}{8}$	33 $6\frac{1}{2}$	$38\frac{1}{2}$ $6\frac{5}{12}$	44 $6\frac{2}{7}$	$49\frac{1}{2}$ $6\frac{3}{16}$			
6	12 12	18 9	24 8	30 $7\frac{1}{2}$	36 $7\frac{1}{6}$	42 7	48 $6\frac{6}{7}$	54 $6\frac{3}{4}$	60 $6\frac{2}{3}$	66 6.6	96 $6\frac{2}{5}$
7	14 14	21 $10\frac{1}{2}$	28 $9\frac{1}{3}$	35 $8\frac{3}{4}$	42 $8\frac{2}{5}$	49 $8\frac{1}{6}$	56 8	63 $7\frac{7}{8}$	70 $7\frac{7}{9}$	77 7.7	112 $7\frac{7}{15}$
8	16 16	24 12	32 $10\frac{2}{3}$	40 10	48 $9\frac{3}{5}$	56 $9\frac{1}{3}$	64 $9\frac{1}{7}$	72 9	80 $8\frac{8}{9}$	88 8.8	128 $7\frac{8}{15}$
9	18 18	27 $13\frac{1}{2}$	36 12	45 $11\frac{1}{4}$	54 $10\frac{4}{5}$	63 $10\frac{1}{2}$	72 $10\frac{2}{7}$	81 $10\frac{1}{8}$	90 10	99 9.9	144 $9\frac{9}{15}$

Equivalents, Chemical, are the figures which express the proportions in which different substances combine with one another or decompose each other, as, for instance, 1 equivalent = 108 parts of silver, combined with 1 equivalent = 8 parts of oxygen, to oxide of silver; and this, combined with 1 equivalent = 54 parts nitric acid, forms nitrate of silver. Or, 98 parts of bromide of ammonium decomposed with 170 parts of silver to form bromide of silver. So also do 98 parts of bromide of ammonium precipitate as much silver salt as 172 parts of bromide of cadmium or 119 parts of bromide of potassium. This should be borne in mind when we wish to exchange in a collodion formula one of these salts with another.

So also correspond 170 parts of silver salt with 58 parts of chloride of sodium, *i. e.*, the last-named quantity of common salt is exactly sufficient to precipitate the previously mentioned quantity of silver salt as chloride of silver.

For all reactions important to photography the following table gives the quantities which come into play.

We give here the equivalents of the substances most used in photography.

Ammonia,	NH_3, =	17
Bromine,	Br, =	80
Bromide of Ammonium,	NH_4Br, =	98
" Cadmium,	$CdBr+4HO$, =	172
" Potassium,	KBr,	119
" Silver,	AgBr,	188
" Zinc,	BrZn,	112.6
Cadmium,	Cd,	56
Calcium,	Ca,	20
Chlorine,	Cl,	35.5
Chloride of Ammonium,	NH_4Cl,	53.5
" Barium,	$BaCl+2HO$,	122
" Calcium,	$CaCl+6HO$.	110
" Gold,	$AuCl_3$,	303.5

Chloride of Sodium,	NaCl,	58.5
" Platinum,	$PtCl_2$,	169.7
" Mercury,	HgCl,	135.5
" Silver,	AgCl,	143.5
Cyanide of Potassium,	KC_2N,	55
Bichromate of Potash,	$KO,2CrO_3$,	147.4
Iron,	Fe,	28
Acetate of Soda,	$NaOC_4H_3O_3+6HO$,	136
Gold,	Au,	197
Iodine,	I,	127
Iodide of Ammonium,	NH_4I,	145
" Cadmium,	CdI,	183
" Potassium,	KI,	166
" Sodium,	NaI+4HO,	186
" Silver,	AgI,	235
" Zinc,		159.6
Lithium,	L,	7
Mercury,	Hg,	100
Nitrate of Silver,	$AgONO5$, =	170
" Uranium,	$U_2O_3NO_5+6HO$, =	252
Nitric Acid,	NO_5,	63
Hydrochloric Acid, *Also* Muriatic Acid,	HCl,	36.5
Sulphuric Acid,	SO_3+HO,	49
Oxygen,	O,	8
Sulphate of Protoxide of Iron (Green Vitriol),	$FeOSO_3+7HO$,	139
Double Sulphate of Iron and Ammonia,	$FeOSO_3+AmOSO+6HO$,	197
Silver,	Ag,	108
Hyposulphite of Soda,	NaO,S_2O_2+5HO,	124
Hydrogen,	H,	1
Zinc,	Zn,	32.6

The atomic weight of substances of which the proportionate amount of water has not yet been exactly determined, is not mentioned (*see* Iodide of Lithium).

Equivalent Focus of a compound lens is the focal length of a single lens which from the same standpoint will form an image of exactly the same dimensions as the combination of lenses. In order to determine the equivalent focus, we draw a square 4 by 6 inches and place it at such a distance from the lens that its image

on the ground-glass is exactly of the same size as the original. We now measure the distance between the ground-glass and the drawing, and divide it by 4.

To facilitate this operation, it is advisable to draw on the ground-glass a square of the same size as on the paper. Another method is to first obtain the image on the ground-glass of natural size and to note the distance between objective and ground-glass. Next we obtain the image of a very distant object and note the position of the ground-glass again; the difference in distance is the focal length (Voigtlander). The amount of light and the field of view depend on the focal length.

Exposure, Long (*see* Exposure).

Exposure, Mistakes in (*see* Negative Process, Failures in).

Exposure, Time of, depends on the weather, the time of the day and year; also on the objective and the greater or lesser brightness of the locality and the object. With portraits, the time may be regulated by a proper arrangement of curtains. *The length of exposure is the reverse of the intensity of the light.* That is, if the light is intense the exposure is short, and if the light is weak a longer exposure is necessary.

The intensity of light is greatest in June and least in December, greatest at 12 o'clock noon and least at sunrise and sunset.

The following table gives the intensity of light in degrees for a clear blue sky, for twelve days in the year, for the fortieth degree of latitude. The numbers are valuable for nearly all the Middle States of the United States. Calculations for other latitudes may readily be made from this.

	0h	1h	2h	3h	4h	5h	6h	7h	8h
21 January,	23.01	21.93	18.64	12.79	2.77	.....	.....	.....	....
21 February,	29.95	29.12	26.53	21.65	14.07	2.77	.....	.....	....
21 March,	34.95	34.40	32.62	28.99	23.00	14.30	2.77	.....	....
21 April,	37.68	37.45	36.55	34.40	30.42	24.05	15.11	2.77	....
21 May,	38.26	38.19	37.77	36.48	33.69	28.73	21.56	11.95	2.77
21 June,	38.35	38.28	38.02	37.01	34.59	30.24	23.71	14.65	5.94
21 July,	38.26	39.19	37.77	36.48	33.69	28.73	21.56	11.95	2.77
21 August,	37.64	37.41	36.48	34.29	30.24	23.80	14.76	2.77	....
21 September,	34.95	34.40	32.62	28.99	23.00	14.30	2.77	.....	....
21 October,	29.63	28.86	26.07	21.28	13.61	2.77	.....	.....	....
21 November,	23.01	21.93	18.64	12.79	2.77	.....	.....	.....	....
21 December,	19.74	18.64	15.43	9.21	.....	.....	.....	.....	....

The numbers 0^h, 1^h, signify the time before or after noon ; 2^h is therefore 10 o'clock before noon, or 2 o'clock after noon, &c. For the days not given in the table, the correct degree is readily found by calculation. For instance, on the 21st of October the intensity of light at 4 o'clock in the afternoon is 13.61, and on the 21st of November at the same hour of the day it is 2.77 ; the difference therefore is for 30 days $= 13.61 - 2.77 = 10.84$, or for 1 day $= 0.361$. The intensity of light for November 1st at 4 in the afternoon would therefore be $13.61 - 3.249 = 10.36$, the difference in time being 9 days and the amount to be deducted 9 times $0.361 = 3.249$. But as the length of exposure is the reverse of the intensity of the light, it follows that if we required 10 seconds on the 21st of October, we will have to expose for 13 to 14 seconds on the 1st of November.

Generally speaking, the following rules should be observed on summer days (from April to September) : The intensity of the light—or, what amounts to the same, the time of exposure—remains about the same between

the hours of 10 to 2; the same takes place in winter-time between 11 and 1 o'clock.

Before and after these hours the time should be increased as the reverse ratio of the figures of the table—moderately in summer and more considerably in winter.

White clouds increase the intensity, while gray ones diminish it.

The light intensity of the apparatus depends on the opening and on the focus. The opening is divided by the equivalent focus, and we find the square of the fraction, which will be the relative intensity of the light. When using a stop, we have to take the size of the opening of the stop in place of the opening of the lens.

For instance:

	Voigtlander, carte de visite.	Busch, System III.	Aujoux, 3 inch.	Steinheil.
Opening divided by focal length,	$\frac{1}{3\frac{4}{11}}$	$\frac{1}{3}$	$\frac{1}{4\frac{4}{7}}$	$\frac{1}{7}$

Therefore the proportion of light intensity is as

$$\frac{1}{11} \qquad \frac{1}{9} \qquad \frac{1}{21} \qquad \frac{1}{49}$$

And the time of exposure as

$$11 : 9 :: 21 : 49$$

If a stop of about half the opening of the lens is interposed, the light will be decreased to nearly $\frac{1}{4}$; with one-third opening, it decreases to $\frac{1}{9}$, and the time of exposure has to be lengthened in proportion—or to 4 or 9 times as long as with the full opening. (See Vogel's *Handbook*, pages 59–78.)

Ether is used to prepare collodion. Its composition is C_4H_5O. Specific weight, 0.736; it boils at 35° Celsius; is very volatile. The most obnoxious impurities are—1. Oil of wine; this remains on the hand after

evaporation, and is detected by its smell. 2. Acid (acetic acid) is produced by the oxidizing influence of the air; it is detected by litmus-paper.

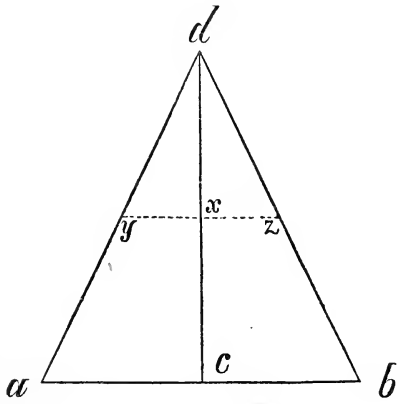
Failures (*see* Positive Process, Failures in; Negative Process, Failures in).

Fe. Chemical symbol of Iron.

Ferridcyanide of Potassium (*see* Prussiate of Potash, Red and Intensifying).

Field of View of a lens is the angle of the field included in a picture. It is found by attaching the lens

Fig. 7.



to a large camera, and by measuring the circle of light. If we draw this circle upon a piece of paper (Fig. 7), *a b*, and erect upon it the vertical line *c d* equal to the length of the focus of the lens, then the angle at *d* is the field of view. (Vogel's *Handbook*, page 59.)

Fixing of Positives. Freshly-made fixing solution

should be taken, and the prints placed into it for at least ten minutes.

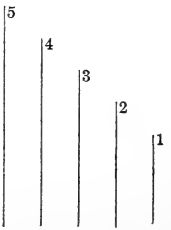
Fixing Soda (*see* Hyposulphite of Soda).

Fixing Soda-Test (*see* Soda-Test).

Fixing Solutions for positive and negative plates: 1 part hyposulphite of soda to 4 : 5 parts of water; for negatives also, 1 part cyanide of potassium to 25 parts of water.

Flare is the bright spot sometimes visible in the neighborhood of bright windows in the pictures or in the centre of the picture. The latter sometimes happens with view lenses; it is a fault of the lens. The former is caused by the reflection of strong light from the surfaces of the lens. Remedy: Cover the windows in front of the lens during three-fourths of the time of the exposure with screens. If the fault is due to the lens, it can be removed by varying the position of the stops.

Focal Difference, is the difference in length of the chemical and optical foci. If with such a lens we focus with the eye as accurately as possible, the resulting picture will not be sharp. We measure the focal differences by placing cards, one behind the other, in the following manner, and designate each with a number:



We focus sharply on the central one (No. 3), and take a picture. When the lens has no focal difference, No. 3 will appear sharp in the picture; otherwise another number

will be brought out sharp, for instance, No. 4. It follows, that in order to obtain a sharp picture of No. 4, we have to focus on No. 3. We next place No. 4 in focus, and notice on the tube of the objective how much we have moved the lens forward or backward. In working with such a lens, we always have to allow this difference.

Focal Length is the distance from the lens at which the rays of light unite, which fall upon the lens parallel to its axis. The focal length is dependent on the curvature and combination of the lenses. At the focal distance we find the images of all the objects which are distant at least fifty times the focal length. Images of objects nearer than fifty times the focal length are farther removed from the lens. If an object is placed at twice the focal length from a lens, the image will be formed at a distance equal to twice the focal length from the centre of the objective.

Focus is the point at which the rays of light intersect, which fall upon the lens parallel to its axis.

Focus, Chemical, means the focus of the chemically active blue or violet rays of light. In a good lens the focus of these rays should coincide with that of the yellow rays; if not the lens has a chemical focus.

Focussing Screen. The ground-glass of the camera, on which the image of the model appears when the lens of the camera is in focus.

Fog. The homogeneous veil which frequently covers the negative plate after development. The causes are manifold.

a. The so-called dark-room admits actinic light. The author always works with subdued lamplight.

b. The plate has been exposed to bright lamplight.

c. The camera or plate-holder is not light-tight, has small holes (in the latter case we will only find spots opposite the holes).

d. Bright light enters through the objective (the latter happens frequently when the camera is placed opposite to a curtain or the bright sky).

e. The collodion is alkaline. A few drops of tincture of iodine will remedy this defect.

f. The bath is alkaline. Remedied by adding acid.

g. The bath contains organic substances. When this is the case, we generally find the plate very insensitive. The remedy is permanganate of potash.

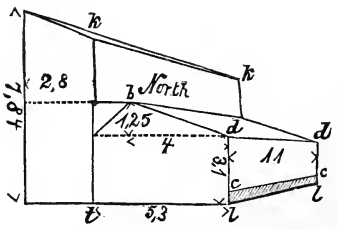
h. The bath contains nitrite of silver. This is not easily remedied, and it is advisable to convert the bath into a positive one. (*See* Positive Bath.)

i. The developer is too strong or too warm.

k. The collodion does not contain sufficient iodizer. Strongly salted collodions require a strong developer, and *vice versâ*.

Gallery, Construction of. *a.* Glass-house, most practical form. North front glass side *l l*, with adjoining glass roof *d d*, inclining towards the north.

FIG. 8.



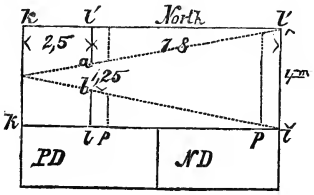
We give the following arrangement as an example:

1. *Large Establishment.*

Length, 11—12.5 metres = 35—40 feet.
Width, 5.3—6.3 metres = 17—20 feet.

Height of the glass side $l\ d = 3.1$ metres = (10 feet).
Height of the unglazed part of the same $e\ l = 62$ centimetres (2 feet).
Width of the glass roof $d\ b$ measured in the horizontal plane, 4—4.7 metres = ($12\frac{4}{5}$—15 feet).
Pitch of the roof $b\ r$, 1.25 metre (4 feet) in 4 metres.

FIG. 9.



Ground Plan.

The back part slants off at b, and is covered with wood and painted the same as the wall of the atelier. Over b is a platform (for printing in the open air); back of this it is advisable to have the printing-room $k\ k$.

Height, 2.8—3 metres (9 feet).
Width, 2.8—3 metres (9 feet).
Length, 11—12.5 metres (35—40 feet).

The front glass wall has an inclination of 28 centimetres on a height of 2.8 metres.

2. *Smaller Establishment.*

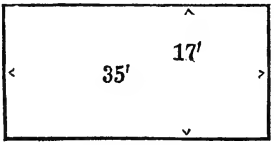
Example:

Length $l\ l$, 7.84 metres (25 feet).
Width, 4 metres ($12\frac{1}{2}$—13 feet).
Depth of glass roof, 2.5—2.8 metres (8—9 feet).
Inclination, 0.8 metre ($2\frac{1}{2}$ feet).

Glass side $l\ l$ always towards the north.

Adjoining is the printing-room *l k*, of 2.5 metres (8 feet) wide. Glass side and skylight as above. The door *a b*, 1.25 metre (4 feet) wide, is placed in the centre, in order to be able to take pictures of persons at full length on plates 18 x 23 centimetres (7 x 9 inches). All the rest as above.

FIG. 10.



Ground Plan.

If it is desired to save glass, the dotted parts *l p*, *l p* = 62 centimetres (2 feet) may remain unglazed.

For pictures of persons full length card size, a length of 6.8 metres = (22 feet) will be sufficient.

Color.—Ultramarine blue.

Curtains.—The best arrangement is with rollers for raising and lowering in a vertical direction. Width, 0.66 metre (2 feet). The curtains should overlap each other like the shingles of a roof.* (For details, see Vogel's *Handbook*, page 1.)

Glass.—The best is white potash window glass. Glass containing manganese or Glauber salts should be rejected. For smaller ateliers, glazing with ground-glass or pasting light paper over the glass is to be recommended.

Backgrounds.—Dimensions at least 2.2 metres wide and 2.5 metres (8 feet) high.

b. Negative Dark-Room (see ND, Ground Plan, Fig. 9).—About 3.75 metres (12 feet) long, 2.5—3.75 metres

* Philadelphia Photographer, 1870, pages 88–116.

(8—12 feet) wide. The room should not be too low. Good ventilation is necessary.

Washing Troughs are best made of asphalted wood, 0.78 metre (2½ feet) wide. The waste water containing silver is collected in these. (*See* Dark-Room.)

c. Positive Dark-Room (see PD).—Similar to negative dark-room.

The dark-room should always be placed next to the atelier or printing-room. It should be kept as cool as possible. Of importance are gas and a plentiful supply of water.

d. Reception-Room.—The arrangement and furniture of the reception-room depends entirely on the necessities of the proprietor and the class of customers. With larger ateliers, dressing-rooms for ladies and gentlemen are desirable. The reception-room should be made attractive by a display of pictures and a selection of books.

Gallic Acid ($C_7H_2O_4+2HO$) is made from gallnuts. It crystallizes in white silky needles, dissolves sparingly in water (different from pyrogallic acid). 100 parts of cold water dissolve 1 part of gallic acid. The solution turns mouldy readily. Alcohol dissolves gallic acid in all proportions. The alcoholic solution keeps unchanged. Gallic acid is not as energetic a reducing agent as pyrogallic acid. With the salts of iron it forms a black solution—ink.

Gelatin (*see* Glue).

Gelatin Iron Developer—

Glacial Acetic Acid, . . .	2 ounces.
Water, ...	8 "
Gelatin, ...	120 grains.

Dissolve, shake, and add after an hour—

Water, ...	70 ounces.
Protosulphate of Iron, . . .	4 "

Glass. A transparent mass, made by fusing together sand with alkalies, lime, and clay. For the photographer it is mainly of importance as being the material for building the atelier (glass-house), and also forming the plates on which the negatives are made. For the glass-house, a material free from iron and manganese should be used—a white, not blue, flat glass. Glass containing iron, manganese, or lead, is changed in color by exposure to light. It becomes yellow, and the chemical rays pass through it less freely. (Gaffield.)

For plates, we have ordinary flat glass with a hard surface, and plate-glass with a soft surface. The latter is easier injured, and the film does not adhere to it as well as to the ordinary glass. The film on plate-glass splits more readily. For very large negatives plate-glass is preferable, as the thinner ordinary glass is easily broken in the printing-frame.

Glass Dishes and Glass Bath (*see* Dishes and Bath).

Glass-house (*see* Atelier; *also* Gallery).

Glass-positives (*see* Diapositives).

Glass-plates (*see* Glass).

Globe Lenses. Strongly curved lenses of a very large field of view (up to 75 degrees), but not as efficient as the pantoscopic lens. They were invented by Harrison & Schnitzer. They have a very small opening; have consequently a feeble light; work only sharp with a stop; the intensity of light decreases towards the margin of the picture; they draw correctly, and are serviceable for taking architectural objects, landscapes, and copying.

Glue. Impure, it is of a yellow color, ordinary glue; pure, it is white (gelatin and isinglass); placed in cold water, it increases in bulk (swells). Is dissolved in boiling water, but not in alcohol and ether. The hot solution coagulates on cooling; it is also coagulated by alum, chromate of alum, and in the presence of light by

a chromic salt; finally by tannin. It is an important material for the carbon (pigment) process, relief printing, and in photolithography.

Dissolved in hot water 1 : 6 it serves as a paste; it is, however, not as convenient as starch.

Glycerin is gained in large quantities in the soap manufacture as a side product. It is thick and oily; specific weight, 1.27. It dissolves readily in water, also in alcohol. It is used for thickening colors; such colors should, however, not be used for retouching negatives, as they are apt to produce a breaking of the film. Glycerin dry plates have so far not been much appreciated.

Gold Bath (*see* Toning Bath).

Gold Chloride. $AuCl_3$. A brown deliquescent salt, easily soluble in water. Is decomposed by light, and forms with chloride of potassium permanent double salts, which can generally be bought pure, for instance, chloride of gold and potassium, $AuCl_3KCl+5HO$, and chloride of gold and sodium gold salt $AuCl_3NaCl+4HO$.

Gold Residues. How to use them. Pour all the remnants of the toning bath into a glass bottle, add muriatic acid and solution of sulphate of iron, shake it well and let it settle. The gold will subside as a brown powder; it is washed on a filter, dried and weighed. One part of it is dissolved in one part of nitric acid, mixed with four parts of muriatic acid; evaporate and dilute again eightfold. The chloride of silver which may have separated is removed by filtering, and the remnant is evaporated again. By the addition of 0.28 potassium chloride we obtain chloride of gold and potassium.

Ground-Glass. Substitute for it is a silvered and washed iodine-collodion plate, or a plate which has been coated with a varnish containing 1 per cent. of tartaric acid.

Gutta-Percha. A substance resembling caoutchouc,

but softening in warm water. It is permanent, most chemicals having no effect on it. It is very suitable for dishes for working prints. Gutta-percha dippers for the negative bath and baths of the same material are not to be recommended, as the resins contained in the gutta-percha are apt to injure the silver solution.

Hyposulphite of Soda (Fixing Soda). $NaOS_2O_2+5HO$, contains water; dissolves readily in water; the solution of this salt dissolves readily the salts of silver, and forms with them the double salts, $2NaOS_2O_2+AgOS_2O_2$, hence its use as a fixing substance.

The solution of the salt is decomposed by acid, sulphur being set free. When this takes place in pictures, sulphide of silver is formed, and the picture turns yellow. If too little soda is present in the fixing solution, an insoluble double salt is formed, $NaOS_2O_2+AgOS_2O_2$; this remains in the picture and causes yellow spots.

The proper strength of the fixing bath is 1:4. At least 4 grammes (64 grains) of hypo per sheet of paper should be allowed.

Hyposulphite of Soda Test. Two clean test-tubes of equal capacity are each filled with about 4 cubic centimetres of solution of iodide of starch; 4–6 cubic centimetres of the water in which pictures have been washed the last time are added to the starch; the latter is diluted with an equal quantity of pure water. The two tubes are now compared by holding them against white paper; if the starch in one of the tubes is bleached, hyposulphite is still present in the water.

Negative plates are tested in the same way, by catching the last drops of water which flow from the negative in one of the tubes.

I. The chemical symbol of iodine.

Intercourse with the Public. 1. Persons should not be kept in waiting too long, or if it cannot be helped, they should be openly informed that they will have to wait.

2. Chemicals, plates, &c., should all be in readiness before the arrangement of the sitter is commenced.

3. Pose as quickly as possible, and do not fix the head-rest until the pose is finished and everything is in readiness for the illumination.

4. Ask if the head-rest causes any inconvenience.

5. Be cool even with annoying accidents and improper behavior of the public.

6. Forget all annoyances which you may have had with the former sitter, and transfer all your energy and amiability to the next comer.

7. Bear in mind that the public frequently considers the finest pictures horrid, and the worst ones beautiful. Do not feel angry at an adverse criticism nor exalted by a favorable one.

Intensifying. 1. With sulphate of iron developer solution: Take 100 parts of water, 2 parts of silver, 2 parts of citric acid, 3 parts of alcohol. This solution freshly mixed with the same volume of developer is poured upon the developed plate previous to washing it.

2. With pyrogallic: 10 parts of pyrogallic, 100 parts of alcohol; of this 4 volumes are diluted with 100 volumes of water. The solution should be used fresh. Equal parts of this and the solution of nitrate of silver mentioned, are mixed together. It may be poured upon the developed and unwashed plate if 2 per cent. of alcohol has been added.

In very warm weather a little more citric acid should be used; in cold weather a little less.

3. With salts of mercury, the best proportion is 1 part

chloride of mercury, 50 parts of water, to which is added, drop by drop, iodide of potassium 1:10, until the red precipitate which forms at first has been redissolved.

It is diluted to 80 and to 100. It is used after fixing and carefully washing the negative.

4. With salts of uranium.

Uranium Saltpetre,	1 part.
Water,	50 parts.

To which is added (freshly mixed),

Red Prussiate of Potash,	1 part.
Water,	50 parts.

When this is placed upon the developed fixed and washed plate, the latter turns brown.

5. Sulphate of ammonium for drawings and photo-lithography. The fixed and washed plate is dipped into the following solution :

Iodine,	3 to 5 parts.
Iodide of Potassium,	10 "
Water,	100 "

It is left in it for ten minutes, and after being washed, sulphate of ammonia is poured over the yellow film.

6. With iodine.

Iodide of Potassium,	5 parts.
Iodine,	1 part.
Water,	150 parts,

are poured over the fixed and washed negative; the film becomes brown ; it is washed with water, and varnished.

7. Intensifying varnished negatives. Alcohol of 90 degrees is poured over the negative three times, in order

to loosen the varnish. To the moist film the following solution is now applied:

Iodine, ...	1 part.
Alcohol 90° (90 parts of Alcohol, 10 parts of Water), ...	150 parts.

The film should not be washed, but is varnished after it has become dry.

Intensifying, Failures of (*see* Negative Process, Failures of).

Instantaneous Pictures require: 1. A lens very strong in light and yielding a flat picture. 2. Strong light (sunlight). 3. A newly-prepared bath 1 : 10, with very little nitric acid. 4. Sensitive collodion (*see* Collodion). In order to prepare plates of the greatest sensitiveness it is advisable to coat them with a plentiful supply of collodion, and to let it flow repeatedly around the margin of the plate before pouring off the excess. Plates may also receive two or three successive coatings of collodion and be made very sensitive in this manner. 5. Strong developer, acidulated: 6 to 10 parts of iron, 100 parts of water, 3 parts of alcohol, 2 drops of sulphuric acid.

Instantaneous Shutter, for the purpose of covering and uncovering the opening of the lens very rapidly. It is best to fix this arrangement separate from the objective, as otherwise it would shake the instrument in opening it. The best instantaneous shutter is the one devised by Rouch (see Vogel's *Handbook*, p. 210).

Iodine. I. Equivalent, 127. A simple body, which crystallizes in black glossy leaves. It evaporates at the ordinary temperature, melts at 107°, boils at 180°, and forms violet vapors. It does not dissolve readily in water, but easily in alcohol, ether, and a solution of iodide of potassium, forming a dark-brown liquid.

The alcoholic solution of iodine, called tincture of iodine, is used for removing stains of silver from the hands, and to give to collodion a yellow color.

Iodide of Ammonium. NH_4I. Equivalent, 145. A white deliquescent salt which by spontaneous decomposition easily turns yellow. It dissolves very readily in water, and rather easily in alcohol and collodion.

Iodide of Cadmium. CdI; atomic weight, 182.7; forms white crystals; has a lustre like mother of pearl; easily soluble in water and alcohol; very permanent; forms double salts with other iodine metals.

Iodide of Lithium. LI+6HO; deliquescent; soon turns yellow; readily soluble in water and alcohol.

Iodide of Potassium. KI; equivalent 166.12; a white salt, which crystallizes in cubes; it dissolves very readily in water, only sparingly and with difficulty in alcohol; it is very permanent. The commercial KI is generally very pure. As it dissolves with so much difficulty in alcohol, it can be used in collodion only in combination with other iodine metals.

Iodide of Silver. AgI; equivalent, 235; a yellow substance, insoluble in water, alcohol, and ether; soluble in hyposulphite of soda, cyanide of potassium, sulphocyanide of potassium; sensitive to light; it is precipitated, when to a silver solution, iodide of potassium or any other iodine salt is added. If the salt of silver is in excess, the iodide of silver is very sensitive to light; otherwise but slightly. Iodide of silver dissolves in the silver baths the more readily the more concentrated they are; more readily in cold than in warm water. If the solution is saturated with iodide of silver, the latter will precipitate in crystals, particularly when warmth is present, and produce small holes—pinholes—on the plate. The crystals are probably iodide of silver, saltpetre.

Iodide of Silver and Nitrate of Silver. Double salt

of iodide and nitrate of silver. Of these compounds there are known $AgIAgONO_5$ and AgI_2AgONO_5; they are not as sensitive to light as iodide of silver, of a paler color, and decompose in water into AgI and $AgONO_5$; the compound forms spontaneously in the nitrate of silver bath, when it is saturated with AgI.

Iodide of Sodium. NaI+4HO; equivalent, 186; white needles, which decompose in the air; dissolve readily in water and tolerably well in alcohol.

Iodide of Starch. 100 grammes of boiling water is poured upon 1 gramme of arrowroot; 20 grammes of chemically pure saltpetre and 20 cubic centimetres of a wine-yellow solution of iodine in iodide of potassium are added; when cold we will have a liquid of a blue color, which on heating becomes discolored. It is used for testing the water in which prints have been washed, for residues of hyposulphite of soda. The solution keeps four weeks. (*See* Soda Test.)

Iodide of Zinc. ZnI; equivalent, 158.6; a deliquescent white salt, easily soluble in water, alcohol, and ether; decomposes readily in the air, leaving oxide of zinc; forms permanent double salts with iodide of ammonium and iodide of potassium.

Iodine, Tincture of. Iodine dissolved in 25 parts of alcohol; it is used for coloring collodion. The tincture decomposes very readily, and it is advisable to make it fresh for use.

Iodized Collodion (*see* Collodion).

Iodizing (*see* Collodion).

Kaolin was formerly used to discolor a bath; it is done much better by permanganate of potash.

Keeping Sensitive Paper (*see* Permanent Sensitive Paper).

Landscape Lenses. Single achromatic lenses with front stop. Nearly every corrected lens is suitable for it. Very often the front lens of a portrait combination is used for it by fitting it into the place of the back lens, the camera side is turned towards the front, and a stop is placed in front of the lens. The field of view and the sharpness of the picture are very variable, according to the curvature of the lenses.

All single landscape lenses distort; they can only be used with stops. (Vogel's *Handbook*, page 64.)

Of landscape lenses especially constructed for the purpose we may mention Dallmeyer's so-called Wide-Angle Lens, Ross's Doublet Lenses (which see), Steinheil's Aplanatic, the Morrison, the Zentmayer, and the Globe.

Doublets, triplets, aplanatic lenses, and Dallmeyer's portrait lens No. D, are used for landscapes when a larger angle, 45° to 60°, correct drawing, and greater intensity of light are desired. For very large angles, the Pantoscope (which see), is to be selected.

Landscape Photography requires the following equipment:

1. Tent (*see* Dark-Tent), as light and movable as possible.
2. Camera.
3. Tripod for the same.
4. Connecting-screw for 2 and 3.
5. Plate-holder, with inside frames.
6. Objectives, with boards.
7. Focussing-glass.
8. Plate-box.
9. Cleaned and polished plates.
10. Duster.
11. Dipper.
12. Cloth for focussing.
13. Can, with water, for washing negatives.
14. Bath or dish for the silver solution.
15. Alcohol lamp.

16. Coal-oil lamp.
17. Iodized collodion—equivalent collodion is preferable—(*see* Collodion, Iodized).
18. Silver bath.
19. Developer.
20. Solution for intensifying.
21. Alcoholic pyrogallic solution.
22. Distilled water.
23. Cyanide of potassium.
24. A couple of empty bottles and corks.
25. Varnish for negatives.
26. Graduated measure.
27. Two funnels.
28. Some developing glasses.
29. Alcohol.
30. Blotting-paper.
31. Writing-paper, for skimming the bath.
32. Matches.
33. Scissors and knife.
34. Twine and a few pins.
35. A small bottle with nitric acid.
36. A small bottle with chloride of mercury,* for removing stains from the clothing.
37. Towels.

For a longer excursion, most of the above-named articles should be taken in duplicate, in order to replace them in case of breakage, together with the following:

1. Scales, with horn dishes.
2. Weights.
3. Nitrate of silver.
4. Protosulphate of iron, or sulphate of iron and ammonia.
5. Glacial acetic acid.
6. Citric acid.
7. Plain collodion.
8. Iodizer.
9. Iodizing salts.
10. Alcohol and ether.
11. Nitric acid.
12. Cleaning rags.
13. Cleaning frames.
14. Tools, screws, screwdriver, diamond for cutting glass.
15. Permanganate of potash for restoring the negative bath.
16. Ammonia for cleaning.

The mixed chemicals should all be tested at home.

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* The bichloride of mercury is excellent for this purpose, as it does not destroy the color.

The quantity of the chemicals depends on the number of plates and their sizes.

For the square foot $= \frac{1}{10}$th square metre, 25 cubic centimetres of albumen solution are necessary (*see* Albumenizing).

Silver bath according to the size of plates. Collodion, 16 grammes; developer, 300 cubic centimetres; intensifier, 48 cubic centimetres; fixing salt (cyanide of potassium), 100 to 150 cubic centimetres.

Water for washing before fixing, 2 litres (4 pints); water for washing after fixing, 8 litres (16 pints); varnish, $7\frac{1}{2}$ cubic centimetres (2 drachms). When water is scarce, the fixing can be left until the return home.

Landscape photography with dry plates requires only the pieces 2 to 7; also No. 12 of the first list and a box for changing the dry plates, or in place of it, a number of plate-holders, one for each plate.

Lenses, Portrait, Doublet, Triplet, and Landscape (*see* Portrait Lenses).

Light, Artificial (*see* Magnesium Light).

Light, Intensity of, and Light-intensity of Lenses (*see* Exposure; *also* Objectives).

Litmus-Paper. 1 part of litmus is bruised in 6 parts of cold water and filtered; sulphuric acid is added until the solution becomes wine-red, not brick-red. Strips of fine white letter-paper are steeped in this and hung up to dry; these papers turn blue when placed into an alkaline solution, and brick-red when an acid is applied. This reagent is not very sensitive, and for delicate work (testing the silver bath) it does not suffice.

Long Exposure requires, in order to prevent the drying of the plates, certain precautions. The most suitable plates are those that have been albumenized. A spongy collodion, which has been iodized with a salt of zinc, should be as thick as possible, or the plate should be

coated several times (*see* Instantaneous Pictures). It is also recommended to keep the camera very cool, placing a wet cloth inside, cleaning the back of the plate, and great cleanliness of the plate-holder. Layers of moist blotting-paper placed at the back of the plate have also proved very useful. Under the edge of the plate a thick layer of blotting-paper should be placed. It is further recommended to pour over the plate after sensitizing distilled water, in the proportion of 3 ounces to a plate of 7 x 9. The water is collected in a bottle, and poured over and over again until the greasy lines disappear. The water which contains some silver is poured over the plate after exposure, and the picture is developed as usual.

Magnesium. Commercial magnesium is generally in the form of ribbon or wire; when ignited, it burns with an exceedingly brilliant and very actinic light; it is used in taking dark interiors. It is burned in a lamp specially constructed for the purpose; the lamp is provided with a reflector. A drawback to the use of magnesium is the thick smoke.

Magnesium Chloride, $MgCl+6HO$, is used in the collodio-chloride of silver process, is deliquescent, and dissolves readily in water and alcohol.

Magnesium Light. For taking a gray wall of 6 feet surface with inscriptions on it, 4 grammes = 60 grains were used, using a portrait tube with $\frac{1}{3}$ opening. For taking a portrait 1.25 gramme was used, one-third on the shadow side and two-thirds on the light side.

Magic Lantern Pictures. Size 82 x 82 millimetres. The lights should be perfectly clear, and the shadows of the (positive) pictures should not be too dense. An intense portrait collodion, diluted with $\frac{1}{2}$ ether, should be used for this purpose; to every ounce of collodion, 1 drop

of nitric acid is added, and the collodion is used at once, as it will only keep for one day, but it makes very clear positives (*see* Diapositives).

Manganese, Peroxide of, is used for making oxygen. For this purpose it is mixed with an equal quantity of chlorate of potash (be careful not to compound it with antimony).

Mastic. A resin which comes to us from the Orient; it is readily soluble in alcohol, and is used in varnishes.

Measure. American: 1 foot = 12 inches; an inch = 12 lines. New (French) measure: 1 metre = 100 centimetres = 1000 millimetres.

Measurement. Table of Measures.—

Feet.	Metres.	Inches.	Centimetres.	Lines.	Millimetres.
1 equals	0.3048	1 equals	2.54	1 equals	2.116
2 "	0.6096	2 "	5.08	2 "	4.232
3 "	0.9144	3 "	7.62	3 "	6.348
4 "	1.2192	4 "	10.16	4 "	8.464
5 "	1.5240	5 "	12.70	5 "	10.580
6 "	1.8288	6 "	15.24	6 "	12.696
7 "	2.1336	7 "	17.78	7 "	14.812
8 "	2 4384	8 "	20.32	8 "	16.928
9 "	2.7432	9 "	22.86	9 "	19.044
10 "	3.0480	10 "	25.40	10 "	21.160
11 "	3.3528	11 "	27.94	11 "	23.276
12 "	3.6576	12 "	30.48	12 "	25.392

1 yard equals 1.093 metre.
1 foot " 30.48 centimetres.
1 inch " 2.54 "

Mercury, Bichloride of. HgCl. A white salt, very poisonous, and soluble in water. At a high temperature it becomes volatile. It changes metallic silver into a black subchloride of silver, and afterwards into white chloride of silver. Silver prints which have not been toned, are bleached by it (magic pictures).

Mercury, Chloride of. Hg_2Cl. Soluble in water. With ammonia it turns black. Is formed by the reduction of the bichloride of mercury.

Mercury, Intensification with. 1. Dissolve one part of HgCl in 40 parts of water, and pour this solution over the fixed and thoroughly washed plate. The latter turns brown. After intensifying, the plate is washed again. Such plates are very apt to print hard pictures.

Mercury, Iodide of, as Intensifier. To a solution of bichloride of mercury, 125, an iodide of potassium solution, 1 : 10, is added. A precipitate of red iodide of mercury is formed, which by a further addition of iodide of potassium is dissolved. Collodion plates which have been fixed and thoroughly washed, are colored by it dark green. They keep better than those which have been intensified with the bichloride.

Mg. Chemical symbol of magnesium.

Mn. Chemical symbol of manganese.

Microphotographs. For taking microscopic objects, a camera is used, the lens of which is screwed on to the instrument of observation, or the microscope itself is used as a photographic lens (Vogel's *Handbook*, p. 203).

N. The chemical symbol of nitrogen.

Na. The chemical symbol of soda.

Negative Collodion (*see* Collodion).

Negative Plates (*see* Glass Plates).

Negative Process. Review in succession of the different operations of the negative process.

a. *Preparations.*

Placing plates in acid, washing and drying with a towel.

Nitrate bath—filtering and skimming.

Developer, intensifier, and fixing bath, to be prepared.

Dipper, plate-holder, clean glasses, and blotting-paper should be got ready.

Preparation of the model and the camera; focussing.

b. *Operations.*

Polishing plates (with ammonia and towel).

Dusting (the duster should not be laid on the table).

Coating with collodion (the latter should never be shaken, and the bottle should be recorked immediately).

Drying the plate while moving it constantly, until the last drop which runs off the plate congeals, and the film at the corner from which the excess of collodion has been poured off, tears in shreds when we pull it with the hand.

Dipping in the silver bath (the corner by which the plate has been held should be lowest. When a dish is used for sensitizing it should be skimmed before immersing a plate).

Moving the plate in the bath until the greasy lines have disappeared.

Taking the plate from the bath, and placing it with one corner on clean blotting-paper.

Placing clean pieces of blotting-paper into the plate-holder.

Placing the plate into the plate-holder.

Closing the plate-holder.

Carrying the plate-holder to the atelier, care being taken to carry it in as vertical a position as possible.

Examining if the picture is well focussed.

Placing the plate-holder in the camera without moving the latter.

Drawing the shutter of the plate-holder.

Exposing (removing and replacing the cover on the objective).

Closing the shutter of the plate-holder.

Carrying the plate-holder to the dark-room.

Placing the developer in a glass.

Removing the plate from the plate-holder.

Pouring the developer on the upper corner of the plate (moving the plate constantly and controlling the development).

Washing for a short time.

Fixing.

Long-continued washing.

Drying.

Warming.

Varnishing.

These are the twenty-eight consecutive operations, which have to be performed with perfect accuracy if we wish a successful picture.

Negative Process, Failures in it.

a. Failures due to the original. Small spots scarcely perceptible to the eye; as, for instance, freckles, or small yellow spots in the paper, become often very prominent in the photograph, and frequently the chemicals are blamed for it.

b. Failures due to cleaning and polishing can be avoided sometimes by breathing on the plate previous to coating it. When the breath adheres unevenly to the plate, it should be repolished. Sometimes, however, the failure shows itself only after development.

1. Glossy precipitate of a silver color between the collodion film and the glass. They are most readily noted by examining the back of the negative, are caused by insufficient cleaning of the plates, particularly when old plates that have been used before are employed. Remedy: The plates should be placed for 12 hours in a solution of chromate of potash; if this is not sufficient, they may still be used by albumenizing them.

2. Moss-like spots, proceeding particularly from the lower corner. The cause is dirty plate-holders. The remedy is to wash the plate-holder with warm water, to dry it, and to line with asphaltum (*which see*).

Coating with negative varnish will also remedy this defect for a short time.

3. Dirty edges, or spots proceeding from the edge and extending more and more towards the centre, are caused by insufficient cleaning of the edges of the plates, or by soiling them by placing them, after they have been cleaned, on a dirty substance (table, paper, or dipper), or by handling them with dirty fingers.

4. Polishing streaks manifest themselves very plainly by showing the direction in which the plate has been rubbed. Small cracks in the glass are frequently the cause of failure, in so far as the polishing powder settles in it.

5. Bright, irregular spots and short lines are caused by dust and woody fibre, which fall on the plate by opening the plate-holder.

c. *Failures due to the collodion* manifest themselves partly after sensitizing, partly after development.

1. The plate, after leaving the bath, has a transparent, insensitive margin; the cause is that the bath has been kept too long after it has been collodionized.

2. The film is rotten and apt to tear in the bath. Causes: The plate has been dipped too soon, the collodion was too old, or the bath was too acid.

3. The film is not equal in thickness, caused by faulty coating.

4. Spots proceeding from the corner by which the plate has been held are caused by dirty fingers.

5. Thick and thin and partly streaky spots are caused by air-bubbles, which have burst when the coating was finished. They are also due to unequal drying of the film, owing to the warmth of the fingers; also by the evaporation of collodion which has run over the back of the plate. Finally, it may be caused by old pyroxylin, which does not dissolve well.

6. Diagonal streaks. The plate has not been properly rocked after the collodion has been poured on.

7. Comets, black spots. Caused by collodion which has been freshly iodized and not settled sufficiently. White and black and worm- or snake-like lines are also caused by collodion which has not settled sufficiently, particularly when potassium salts are employed, which do not dissolve readily. They disappear when the collodion has settled. Filtration will also remove this trouble.

8. Cross-like or shingle-shaped drawings are apt to form when the temperature is very low or when the collodion contains much water.

9. Black, irregular spots. Caused by dirt in the neck of the collodion bottle.

10. Collodion which has worked well for some time, all at once yields imperfect plates. Cause: by pouring the excess of collodion from the plates back into the bottle impurities are introduced. Remedy: collect the excess in a separate bottle.

11. Insensitiveness is met with when the collodion is very old and of a deep-red color.

12. The film does not adhere to the plate. Cause: an old and acid bath, badly cleaned plates, old pyroxylin.

13. The picture has a honeycombed structure. Cause: the collodion was too tough. Remedy: the cotton is first dissolved in ether, allowed to settle, and decanted, and the alcohol is added to the clear liquid.

14. Veils. Caused by alkaline collodion. Remedy: add tincture of iodine.

d. *Failures caused by the nitrate bath.*

1. White streaks in the direction of the dip, partly horizontal and straight lines with upright bath, partly curved with dishes, and sometimes round spots, which

are detected after sensitizing ; they are caused by imperfect immersion of the plate into the bath, or too little solution in the dish.

2. Black streaks in the direction in which the plate has been dipped (particularly with an upright bath ; sometimes they also occur when silvering in dishes and when the film is turned downward). Cause : the plates have remained too short a time in the nitrate bath, or the bath was very old and surcharged with organic substances.

3. Black streaks which proceed from the dipper. Cause : dirty gutta-percha dipper.

4. The film is partly eaten away. Cause : the bath contained either none or too little iodide of silver.

5. Peculiarly transparent and pale plates, which possess but little sensitiveness, are sometimes met with in very hot weather. Remedy : cool the silver bath by means of ice, or with a wet cloth and a draft of air.

6. Spears, crosses, and swords. Cause : the bath contains sulphate of silver or acetate of silver.

7. The plates look as if they had been dusted over with flour. Cause : iodide of silver is thrown out in large quantities in hot weather. The only remedy is filtration and cooling.

8. Small holes like pinholes. Cause : the bath contains much iodide of silver. Remedy : cooling and restoring by diluting with four times the bulk of water, filtration, and evaporation.

9. Black spots on the collodion film are frequently produced by small pieces of glass projecting from the sides of the bath or the bottom of the dish.

10. Want of sensitiveness is caused by too much acid, also by organic substances. Remedy : neutralizing or treatment with permanganate of potash.

11. Gray and grizzly spots are due to imperfect skimming of the bath.

12. Veils or fog are due to an alkaline bath and to organic substances in the bath.

13. Weak pictures are frequently due to the use of a bath which is too old and has frequently been restored.

e. *Failure in exposing.*

1. Want of sharpness or double outlines. Cause: faulty focussing; the model did not sit still or the apparatus was shaken during exposure.

2. Marbled spots and drying spots are formed when the exposure has been too long, or the bath very fresh, or by heat (*see* Long Exposure).

3. Hardness of the picture. The exposure was too short. A weak picture is sometimes also the consequence of too long an exposure.

4. The picture appears to be of unequal intensity. Cause: unequal illumination, particularly with drawings.

5. Foggy spots are caused by the light being reflected from drawings or oil paintings. Remedy: the illumination should be changed.

6. Fog is produced by side-light, or sometimes it is caused by the bright sun shining into the objectives, or a similar reflection from the clear sky.

7. Double pictures are caused by small holes in the front of the camera.

8. Unequally illuminated stereoscopes (and sometimes single pictures) are caused by the lenses having unequal intensity of light, or the plate not being covered with a collodion film of equal thickness. In the latter instance, the thickest part of the film will show the most intense picture.

f. *Failure in the development.*

1. A bright spot at the place where the developer has been poured on. Cause: the developer has been poured on too violently.

2. Curved lines developing streaks. Cause: the developer did not flow evenly.

3. The film repels the developer. In this case the developer contains either too much alcohol (for instance, with a fresh bath), or too little (for instance, with an old bath).

4. A dark margin to bright objects, which appears at the side where the developer has been poured on (appears in the positive as a halo), is a very common consequence of faulty development.

5. Fogs are sometimes caused by too strong a developer, by too much heat, or by too little acid in the developer.

6. Most of the above failures show themselves only during development, although they are not, strictly speaking, due to faulty development.

g. *Failures of intensifying.*

1. The intensifying solution is poured off, and leaves spots (particularly when we intensify with iron salts). Caused by want of alcohol.

2. Pale spots are due to the same cause, when the intensifier, no matter from what cause, does not flow evenly over the whole plate.

3. A gray granular precipitate is formed when the action of the iron intensifier is continued until it becomes muddy.

4. Bluish precipitate forming in the shadows is caused by want of acid, or when we employ an old pyrogallic solution.

5. Thick and heavy spots are formed when the intensifier, particularly in long-continued intensifying, is always applied to the same spot.

h. *Failures in fixing.*

1. The plate is greenish or bluish; this is due to traces of iron salt being left on the plate, which, with cyanide

of potassium, forms a green or blue precipitate. It is avoided by thorough washing previous to fixing.

2. Black streaks (generally only recognizable by looking from above). Cause: the fixing solution was too cold, too thin, or insufficiently applied.

3. Thin spots are formed by too strong a solution of cyanide of potassium, which eats the film away.

i. *Failures which appear on drying the plates.*

The film has iridescent colors, and peels off. This takes place with plates which have been intensified too long or exposed too little. These plates may be saved by varnishing them when still moist, and after they have become dry they are revarnished warm.

k. Failures in varnishing.

1. The film becomes detached; the picture is floated off. Cause: the alcohol in the varnish is too strong; add 1 per cent. of water.

2. A dull plate is due to the varnish being too thin, or the plate was too cold.

3. A streaky film is due to moving the plate unequally while drying, or the plate was too hot.

NH_3, the chemical symbol of ammonia.

Nitrate of Silver (*see* Silver Nitrate).

Nitric Acid. HO,NO_5. Commercially we have common nitric acid, containing muriatic and sulphuric acid, and pure nitric acid of 1.2 specific gravity; also more concentrated of 1.4 to 1.5 specific gravity, always containing water. For cleaning plates, the common acid suffices; for dissolving silver, the pure acid should be used.

For making pyroxylin (*which see*), and for making aqua regia, a more concentrated acid should be used (1.4 specific gravity). The amount of anhydrous acid, NO_5, which is present in a hydrate (NO_5HO) is found by the following table:

Amount of Nitric Acid Hydrate and Anhydrous Nitric Acid contained in Nitric Acid.

100 parts contain Nitric Acid.		Specific Gravity at		100 parts contain Nitric Acid.		Specific Gravity at	
Hydrate.	Anhydrate.	0°	15°	Hydrate.	Anhydrate.	0°	15°
100.00	85.71	1.559	1.530	58.88	50.47	1.387	1.368
99.84	85.57	1.559	1.530	58.00	49.71	1.382	1.363
99.72	85.47	1.558	1.530	57.00	48.86	1.376	1.358
99.52	85.30	1.557	1.529	56.10	48.08	1.371	1.353
97.89	83.90	1.551	1.523	55.00	47.14	1.365	1.346
97.00	83.14	1.548	1.520	54.00	46.29	1.359	1.341
96.00	82.28	1.544	1.516	53.81	46.12	1.358	1.339
95.27	81.66	1.542	1.514	53.00	45.40	1.353	1.335
94.00	80.57	1.537	1.509	52.33	44.85	1.349	1.331
93.01	79.72	1.533	1.506	50.99	43.70	1.341	1.323
92.00	78.85	1.529	1.503	49.97	42.83	1.334	1.317
91.00	78.00	1.526	1.499	49.00	42.00	1.328	1.312
90.00	77.15	1.522	1.495	48.00	41.14	1.321	1.304
89.56	76.77	1.521	1.494	47.18	40.44	1.315	1.298
88.00	75.43	1.514	1.488	46.64	39.97	1.312	1.295
87.45	74.95	1.513	1.486	45.00	38.57	1.300	1.289
86.17	73.86	1.507	1.482	43.53	37.31	1.291	1.274
85.00	72.86	1.503	1.478	42.00	36.00	1.280	1.264
84.00	72.00	1.499	1.474	41.00	35.14	1.274	1.257
83.00	71.14	1.495	1.470	40.00	34.28	1.267	1.251
82.00	70.28	1.492	1.467	39.00	33.43	1.260	1.244
80.96	69.39	1.488	1.463	37.95	32.53	1.253	1.237
80.00	68.57	1.484	1.460	36.00	30.86	1.240	1.225
79.00	67.71	1.481	1.456	35.00	29.29	1.234	1.218
77.66	66.56	1.476	1.451	33.86	29.02	1.226	1.211
76.00	65.14	1.469	1.445	32.00	27.43	1.214	1.198
75.00	64.28	1.465	1.452	31.00	26.57	1.207	1.192
74.01	63.44	1.462	1.438	30.00	25.71	1.200	1.185
73.00	62.57	1.457	1.435	29.00	24.85	1.194	1.179
72.39	61.05	1.455	1.432	28.00	24.00	1.187	1 172
71.24	61.06	1.450	1.429	27.00	23.14	1.180	1.166
69.96	60.00	1.444	1.423	25.71	22.04	1.171	1.157
69.20	59.31	1.441	1.419	23.00	19.71	1.153	1.138
68.00	58.29	1.435	1.414	20.00	17.14	1.132	1.120
67.00	57.43	1.430	1.410	17.47	14.97	1.115	1.105
66.00	56.57	1.425	1.405	15.00	12.85	1.099	1.089
65.07	55.77	1.420	1.400	13.00	11.14	1.085	1.077
64.00	54.85	1.415	1.395	11.41	9.77	1.075	1.067
63.59	54.50	1.413	1.393	7.22	6.62	1.050	1.045
63.00	53.14	1.404	1.386	4.00	3.42	1.026	1.022
61.21	52.46	1.400	1.381	2.00	1.71	1.013	1.010
60.00	51.43	1.393	1.374	0.00	0.00	1.000	0.999
59.59	51.08	1.391	1.372				

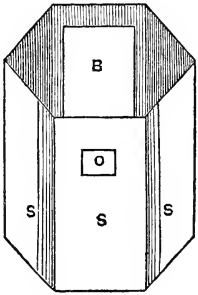
NO_5. The chemical symbol of nitric acid.

Objective (*see* Portrait Objective; Landscape Objective; Stereoscopic; Wide Angles; Triplet; Orthoscope, &c.).

Oil Paintings, Reproduction of, according to Goupil and Scamoni.

The picture B is placed in the open air behind the

FIG. 11.



screens S, in order to avoid reflection; the camera is placed in front of the opening O.

Collodion with iodide of cadmium, bromide of zinc, and bromide of ammonium, is used.

Nitrate bath with 3 per cent. nitrate of zinc, in order to avoid drying. See page 92.

Opening. The diameter of the objective.

Opening, Relative, is the fraction which we obtain when we divide the diameter of the lens by the length of focus. The square of the same is the measure of the light intensity.

Optical Picture is the real picture of a collecting lens in contradistinction to the imaginary picture of a dispersing lens.

Orthoscope. A combination of lenses calculated by Petzval; it has a large, convex front lens, small, concave back lens, for landscape and architectural pictures; it has a very flat and large field, but the lines at the margin are curved. The lens is scarcely used now; the triplet and Steinheil lenses are better.

P. The chemical symbol of phosphorus.

Panoramic Apparatus. A camera which turns on a pivot and has a movable plate-holder. The whole horizon, or one-third to a half of it, can be taken with a simple landscape lens. The foreground to the right and left is often too large, and the horizontal lines are curved. It is only suitable for landscapes, but unfit for architectural objects.

Pantascope (*see* Wide-Angle Lenses).

Paste. Starch is rubbed with a little cold water to a smooth paste, and boiling water is added to it until the whole mass suddenly becomes stiff. If the paste does not become stiff, the temperature of the water was too low, or else there was not sufficient starch. If this is the case, the vessel containing the starch should be placed in another vessel with boiling water, and stirred frequently. Eventually more starch should be added.

Pb. The chemical symbol of lead.

Permanganate of Potash. Purple-black, glossy, needle-shaped crystals of an intense red color, soluble in water; energetic oxidizer, and hence a valuable agent for destroying organic substances in old silver baths. It is added drop by drop in solutions 1 : 50 to 1 : 100. The solution decomposes gradually, oxide of manganese, MnO_2, being thrown out.

When we wish to restore a silver bath we add the solution of permanganate drop by drop to it, agitating the

bath constantly. When the rose tint of the bath disappears after three minutes, it shows that organic matter is still present. We continue to add permanganate until the rose color remains for at least three minutes. The bath becomes by the addition more alkaline than before, and it is necessary to acidulate it in order to avoid fog. With the positive bath this is not necessary.

Pigment Process (Carbon Process). How to work it according to Johnson:

1. Sensitizing of the pigment gelatin sheets by immersion in a solution of chromate of potash, 1 : 30.
2. Drying.
3. Exposure to light under a negative with a timing photometer.
4. Gluing on a waxed zinc plate.
5. Drying.
6. Placing on transfer paper; drying.
7. Detaching; toning; trimming and pasting as usual. (Vogel's *Handbook*, page 175.)

Picture, Size of. The size of the picture which an objective or a lens produces of an object is dependent on the one hand on the distance between the lens and the object, for the further the two are removed from one another, the smaller will the image be. On the other hand, it depends on the focus of the objective, and the longer the focus of a lens or a combination of lenses is, the larger will be the image.

Both these conditions are expressed by the formula—

$$B = \frac{G\,p}{a - p}$$

B being the size of the image, G the natural size of the object, a its distance, and p the focus.

Example: A person 5 feet high is placed at a distance of 15½ feet from an objective of 6 inches focus. Then—

$G = 5$ feet; $p = 6$ inches $= \frac{1}{2}$ foot; $a = 15\frac{1}{2}$ feet

And

$$B = \frac{5 \times \frac{1}{2}}{15\frac{1}{2} - \frac{1}{2}} = \frac{\frac{5}{2}}{15} = \frac{5}{30} = \frac{1}{6} = 2 \text{ inches.}$$

In the optical prices current the term size of picture means the image which a lens will form when an object is placed at or near the focal distance of the lens. This size depends also on the field of view, for with an increase of the latter the size of the picture will increase also. The pantascope, for instance, yields the largest picture, equal to twice the focal length, but all the objects in the picture are very small, owing to the short focal length.

This size of picture, or, better, field of picture, is—

In the Pantascope . . .	twice the focal length.
In Steinheil's Aplanatic Lens .	equal to the focal length.
In Dallmeyer's Landscape Lens .	" " "
In Dallmeyer's Triplet . .	$\frac{5}{8}$ of the focal length.

In portrait lenses variable according to the system. For instance—

Busch System, I and II, . .	$\frac{3}{4}$ of the focal length.
" " III and IV, . .	$\frac{2}{3}$ " "

(See Vogel's *Handbook*, p. 76.)

This field of the picture refers, however, only to the focal distance as relating to the ground-glass. If the object is placed very close to the lens, its image will be removed very far from it, and the size of the picture will increase accordingly. An objective which, at the focal distance, will give an image of 10 inches diameter, will form at twice that distance an image of 20 inches diameter. A carte de visite objective will reproduce a negative of life-size if the negative is placed at the focal distance (*see* Enlargements).

Plates (*see* Glass).

Plates, Washed, wet for long exposure. The sensitized plate is dipped in distilled and slightly acid water, until the greasy lines have disappeared. The excess of water is allowed to drip off, and the plate is placed in the plate-holder with a backing of blotting-paper. Time of exposure, about one and a half times that of an ordinary wet plate. Previous to development, the plates are dipped again into the silver bath and moved about until the greasy lines have disappeared.

Plates, Dry (*see* Dry Plates).

Plates, Cleaning of (*see* Cleaning Plates).

Plate-Holder. The plate-holder should be perfectly light-tight, and should correspond exactly with the ground-glass (*see* Camera); it should be so constructed that the plates rest firmly in it. The best support for the glass-plates is silver wire or hard rubber; the glass should not come in contact with the wood at all. The best coating for the interior of the plate-holder is asphaltum varnish. A receptacle underneath the plate for collecting the drippings is to be recommended. The plate-holder should be kept scrupulously clean, by wiping it with blotting-paper, by washing and drying it after every day's work, and by placing strips of blotting-paper under the lower corner of every plate.

Porcelain Pictures (*see* Collodio-Chloride of Silver).

Portrait Objective. Arrangement: Two compound lenses (crown and flint glass), more or less distant from each other, are placed into a brass tube F. (For form and arrangement, see Fig. 12.) A is the front lens, the parts of which are cemented together; B is the back lens, the component parts of which are separated by a ring; *f* is flint glass, and *c* is crown glass.

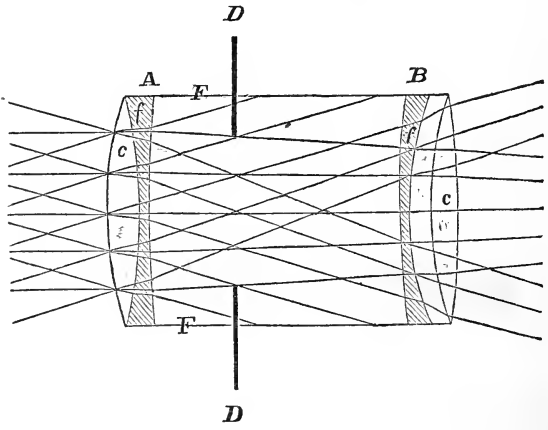
With conical objectives (a cone; see Fig. 13), the back lens is much larger than the front lens. The consequence

is that the margin is much brighter, but the image lacks sharpness.

The front lens is also used by itself for taking landscapes (*see* Landscape Lenses).

Of a portrait objective a picture as large as possible is demanded, also the greatest possible depth, sharpness,

Fig. 12.



and light intensity. The light intensity is greater in proportion the larger the opening (the diameter of the lens) and the shorter the focus. (For determining the latter *see* Focus.)

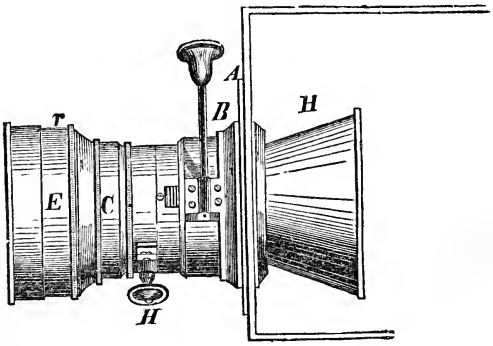
The fraction $\frac{\text{opening}}{\text{focus}}$ raised to the square is the relative light intensity (see above).

With small portrait lenses of good quality a relative opening of 1 : 3 to 1 : 3.8 gives satisfaction generally. These lenses give a picture of about two-thirds to three-fourths the length of the focus.

For instance, Voigtlander A, of 3.85 relative opening, has 167 millimetres focus, and yields pictures of 123 millimetres.

Objectives of *very large opening* (over one-third) have very great light intensity, but the size of the picture is smaller, and these rapid workers are frequently only suited for bust pictures (*see* Children's Pictures).

Fig. 13.



The depth increases when the relative opening is diminished—a proof that a great amount of light and depth are not often found together.

In selecting an objective, the distance also should be taken in consideration. Short ateliers should have objectives of short focus; but otherwise objectives with a long focus are preferable. Considering, however, that at present scarcely one-fourth of the pictures ordered are full-length pictures, we generally get along with objectives calculated for shorter distances.

We give a list of the best known makers.

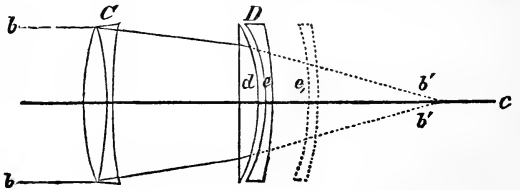
Of German objectives, Voigtlander's are the most in use.

Of English objectives, Dallmeyer's and Ross's are most in use in America.

As catalogues of them are supplied by the several agents for them, we omit further references to the sizes.

The arrangement of Dallmeyer's patent portrait lens is explained by

FIG. 14.



The back lens D is placed in a reversed position from the Petzval construction, and the position of the flint glass *e* can be changed from the side nearest the camera, in order to get greater depth of focus (Vogel's *Handbook*, page 68).

Of French objectives we will mention only a few. Special references can be found in most of the French prices-current.

Portrait Photography, Glass House for it (*see* Gallery). Collodion for portraits (see formulæ, page 24); developer (see the same); intensifying with sulphate of iron or pyrogallic acid (*see* Intensifying); fixing (see the same).

Positive Bath. 1 part of nitrate of silver, 10 parts of water, a few drops of carbonate of soda in order to keep it neutral. The precipitate of carbonate of silver should be left in the bottle.

Positive Bath, Preparation of it from Negative Baths.— The negative bath is diluted to one-quarter of its former

strength, left to settle, and the clear solution is decanted (or filtered). It is now evaporated to dryness in a porcelain dish, and the mass is gently fused; when cooled, it is dissolved in water in the proportion of 1 : 10 and filtered; after filtration it is neutralized and ready for use.

Positive Transparencies (*see* Diapositive and Magic Lantern Pictures).

Positive Process, also Printing Process, consists of the following operations:

Sensitizing the paper; in summer forty-five to sixty seconds, in winter seventy-five seconds.

Drying.

Placing the paper in the printing-frame.

Exposing.

Washing in four changes of water.

Toning.

Fixing.

Thorough washing.

Drying.

Trimming.

Mounting and Drying.

Rolling.

Positive Process, Failures in.

a. *Failures in the Silver Bath.*—1. Air-bubbles betray themselves as white spots in the finished print; they are removed by means of a glass rod; the sheet is lifted with it from the bath immediately after floating it on it, and after being examined carefully for bubbles, it is returned.

2. *The paper repels the silver bath;* the cause is, the albumen film is too dry; the paper should be placed for twenty-four hours in a cool cellar previous to using it.

3. The silver solution, on drying the paper, adheres in drops to the centre of the sheet; this is partly avoided in

the same way as stated under No. 2; the drops may also be removed by blotting-paper.

4. The paper is dried too much or too little; when this has been the case, the print is apt to be weak, unequal, or it ruins the negatives by adhering moisture.

5. The bath turns brown; this is caused by the silver solution dissolving the glue of the paper; it takes place only when the bath is too thin; it should be discolored by permanganate of potash (which see) and strengthened.

6. Grayish dirt is caused by imperfect scumming.

b. *Failures in Printing.*—1. The picture looks weak, the shadows are dull, and the high-lights dim. Cause: An acid silver bath or an old and diluted silver bath; the paper has been dried too much or too little; the negative was too thin; in the latter case the printing should be done through green glass or the back of the negative should be coated with a varnish containing dragon's-blood (*see* Dragon's-blood Varnish; *also* Iodine Varnish).

2. Feeble lights are often caused by examining the print too often in open daylight.

3. The print turns yellow after long-continued printing. Cause: the sheet is decomposed. Remedy: place waxed paper behind the paper or sensitize on a bath containing citric acid.

4. Brown streaks. Cause: remnants of fibrin in the albumen.

5. The print is partly not sharp. Cause: the paper is not thoroughly pressed against the negative or the paper is wavy. This occurs when the printing-room and the sensitizing-room vary very much in temperature. Remedy: place the paper, after being dried for half an hour, in the printing-room.

c. *Failures in Washing.*

1. Black precipitates are formed by substances being present in the water containing sulphur, or by remnants of hypo adhering to the sides of the dishes, particularly with gutta percha-dishes.

2. Brownish-black spots are formed by handling the paper with fingers containing soda.

d. *Failures in Toning.*

1. The bath tones unequally. Cause: too little gold solution, insufficient immersion of the prints, or agitation of the bath. The prints have stuck together during the toning and the gold solution cannot penetrate; finally, if the prints have been laid away for some time previous to being toned.

2. The print does not tone at all. Cause: *a.* Much iodide of silver, or much acid, or foreign metals are contained in the positive bath, as for instance when the bath has been made from an old negative bath. Such a bath should be diluted four or five fold, in order to remove the iodide of silver. It should next be evaporated to dryness, and fused gently for some time. The acid escapes and the salts of the foreign metals are mostly decomposed.

b. The water is contaminated with substances containing sulphur. (See above.)

c. Gold solution is wanting.

3. The lights become dim when the room in which the prints are toned is too light.

e. *Failures in Fixing.*

1. Streaks are formed when the pictures are immersed unequally into the fixing solution, or spots when the fixing solution is sprinkled on the prints previous to immersion.

2. Yellow spots (which frequently become visible only when the prints are finished). Cause: air-bubbles in the paper. Remedy: each print should be moved ener-

getically when placed in the bath, or the solution should be brushed over it.

3. The fixing bath is old. The prints are apt to turn yellow very soon.

4. Cloud-like spots, which afterwards turn yellow, are caused by the print being placed for too short a time into the fixing bath, or the quantity of fixing solution was not sufficient for a large number of prints.

f. *Failures in Washing after Fixing.*

1. The pictures are spotted (pockmarked), *i.e.*, the albumen film forms blisters. This happens on placing the fixed copies in water. In this case they should be placed in $\frac{1}{4}$ diluted hypo solution, next in solution of $\frac{1}{10}$ the strength, and finally in water.

2. The prints stick together, or adhere to the sides of the vessel. They turn yellow very soon in consequence of the hypo remaining in the paper.

3. The washing has been insufficient. The pictures turn yellow.

g. *Failures in Finishing.*

1. The pictures become yellow-spotted. This may be caused by drying them with blotting-paper which has been used too often, and in consequence has absorbed hypo.

2. The same result may follow if the mounts on which the prints are mounted contain soda or sulphur.

3. The prints are sometimes turned yellow by using old and sour paste.

4. The prints become wrinkled in the rolling press. Cause: the rollers are not parallel to each other, or the mount has warped too much. Remedy: the prints should be pressed first under a flat board, in order to flatten them.

Potash, Chromate of. *a.* Yellow or neutral, KO,CrO_3. A yellow salt, which does not crystallize readily, decom-

poses very easily, and dissolves freely in water. Very often impure.

b. Acid or red KO_2CrO_3. A very permanent salt. By itself it does not change in the light, dissolves in 10 parts of water of a temperature of 15° C. A less proportion dissolves in cold water. Combined with organic substances it decomposes in the light. Important material for photolithograph and lichtdruck processes. It is also indispensable in the Carbon and the Woodbury printing processes. It is far more sensitive than nitrate of silver. It is very poisonous.

Sulphuric acid liberates chromic acid, and this has a caustic action, hence a mixture of $1KO_2CrO_3$, 1 part sulphuric acid to 20 parts of water, is used for cleaning glass plates.

With the following table the percentage of chromate may be determined, ascertaining the specific weight of the solutions.

Parts of salt in 100 parts of water.	Percentage of Salt in the solution.	Chromate of Potash. Density, Water = 1.	Chromate of Ammonia. Density, Water = 1.
1	0.990	1.0080	1.0060
1.5	1.477	1.0120	1.0080
2	1 960	1.0160	1.0105
2.5	2.439	1.0195	1.0130
3	2.912	1.0225	1.0150
3.5	3.381	1.0255	1.0175
4	3.846	1.0280	1.0200
4.5	4.306	1.0300	1.0230
5	4 761	1.0325	1.0260
6	5.600	1.0385	1.0300
7	6.542	1.0450	1.0350
8	7.407	1.0510	1.0400
9	8.257	1.0570	1.0450
10	9.091	1.0630	1.0500

Preservative Process (*see* Dry-Plate Process, Albumen Process, and Collodio-Bromide of Silver Process).

Printing Process (*see* Positive Process).

Prussiate of Potash, Red, is used for intensifying, according to Selle's process.

Pyrogallic Acid. $C_{12}H_6O_6$. A white and dry substance, produced by the distillation of gallus extract; dissolves readily in water and alcohol; an energetic reducing agent; is used for intensifying, and in the dry-plate processes for development.

The watery solution spoils very soon, and turns brown. The alcoholic solution is unchangeable, and keeps for years; mixed with ammonia, it turns brown by absorbing oxygen.

Pyroxylin is the scientific name for nitro-cellulose. Photographically it is important as the material from which collodion is made. Commercially we meet it partly as gun-cotton and partly in the form of paper; the latter is generally of a better quality than the former. Preparation: immersion of cotton or tissue-paper in a mixture of nitric and sulphuric acids.

The best proportions for collodion paper is, according to Zettnow (*Photographische Mittheilungen*, January, 1872, page 248),

	Sp. Gr.
50 cubic centimetres (or $1\frac{3}{4}$ fluid ounces) Nitric Acid, ...	1.47
100 cubic centimetres (or $3\frac{1}{2}$ fluid ounces) Nitric Acid, ...	1.364

Or,

150 cubic centimetres (or $5\frac{1}{4}$ fluid ounces) Nitric Acid, ...	1.4

Add

	Sp. Gr.
150 cubic centimetres (or $5\frac{1}{4}$ fluid ounces) Sulphuric Acid,	1.845

At a temperature of 50° C., about 18 grammes (270 grains) of silk tissue-paper are immersed in strips, and left in the acids for half an hour; they are then removed, thoroughly washed and dried.

For cotton pyroxylin, Hardwich recommends

	Sp. Gr.
18 parts Sulphuric Acid,	1.84
6 " Nitric Acid,	1.45
5 " Water,	
$\frac{5}{8}$ " Cotton.	

At 60° C., the cotton is immersed for about ten minutes. It is preferable to employ the weaker nitric acid of commerce instead of diluting the concentrated acid with water (*see* Nitric Acid).

Rapid Lenses have large openings and short focus (*see* Instantaneous Pictures and Children's Pictures).

Rapid Rectilinear Lens, of Dallmeyer, is constructed after Steinheil's aplanatic lens. Opening 1 : 8; otherwise, its performances are similar to Steinheil's lens.

Rapidity of Lenses (*see* Light Intensity).

Reagent Paper (*see* Litmus).

Reaumur Thermometer (*see* Thermometer).

Rectilinear Lenses (see Rapid Rectilinear Lenses).

Red Prussiate of Potash. A salt soluble in water, sensitive to light; mixed with uranium salt, it is used as uranium intensifier (which see).

Redeveloping (see Reinforcing).

Reducing the Sizes of Pictures (*see* Enlargements).

Reducing Intensity of Negatives. 1. Not varnished. Pour on

Iodine, ...	1 part.
Iodide of Potassium, ...	10 parts.
Water, ...	150 parts.

Let it act awhile. Negative becomes by the iodine denser. Now pour on

Cyanide of Potassium, ...	1 part.
Water, ...	25 parts.

The color changes immediately, and the negative becomes thinner.

2. Varnished negatives. Pour on three times alcohol of 90°; then tincture of iodine (1 part iodine, 150 parts of alcohol of 90°); then cyanide 1 part; alcohol 80°, 50 parts. Wash and dry.

Reinforcing (*see* Intensifying).

Reinforcing, quantities of chemicals used (*see* Intensifying; *also* Consumption of Chemicals).

Reproductions of drawings, oil paintings, &c.

1. The drawing or painting and the apparatus are placed in such a manner that the ground-glass and the drawing are parallel to each other, in order to avoid distortion.

2. In illuminating the drawing, reflection of light should be avoided.

3. A very sensitive collodion should be selected.

4. Illumination must depend on circumstances. With oil paintings a very long exposure is sometimes necessary. (For avoiding drying spots, *see* Plates, Washed.)

5. Paintings with much half tone, oil paintings with strong line drawings, should be developed with a weak developer.

6. Intensifying (see this article; also Vogel's *Handbook*, page 219; also Oil Paintings).

Residue, Saving of (*see* Gold and Silver Residue).

Restoring the Nitrate Bath. *a.* Positive bath. The bath has turned brown; it should be boiled down, or, better, a solution of permanganate of potash 1 : 50 is added until the bath has become clear. An acid bath is neutralized with carbonate of soda. A weak bath (*see* Silver Test) has to be strengthened.

b. Negative bath. A bath which gives foggy pictures should be acidulated, or iodine added to the collodion. A bath which is very insensitive and fogs is restored carefully with permanganate of potash (which see). A bath which is too weak is strengthened. When it contains an excess of iodide of silver, it is diluted, left to settle, filtered, and evaporated to the required strength. Very old negative baths are best converted into positive baths (which see).

Retouch, negative and positive, is more a matter of manual skill and feeling than of formulæ. For details, consult the *Philadelphia Photographer* and Ayres's *How to Paint Photographs.*

Retouching Color. According to Grasshoff, a solution of gum arabic 1 : 5 is rubbed with the finger in a small dish with finest lampblack; to this is added caput mortuum or Paris red until the desired tone is reached. If a more bluish tint is desired, a little indigo or cobalt may be added (but not ultramarine, which contains sulphur).

S. The chemical symbol of sulphur.

Saccharate of the Protosulphate of Iron we call in photography a substance produced by evaporating a solution of protosulphate of iron and sugar. According to Benque, 4 parts of powdered sulphate of iron and ammonia and 1 part of sugar are formed into a paste

with a little water; the substance is now heated, stirring it constantly, until it turns brown and bubbles commence to form. It is now set aside to cool, the brown lye is separated from the crystals, the latter are dried and 2 parts are dissolved in 20 parts of water; $\frac{3}{4}$ parts of glacial acetic acid and $\frac{3}{4}$ parts of alcohol are added. A developer made with this material is said to work clearer and finer.

The same effect is produced by adding to an ordinary developer from 1 to 3 per cent. of sugar.

Saving of Silver Residue (*see* Silver Residues).

Sel d'or. Double compound of hyposulphite of soda and hyposulphide of the oxide of gold $AuOS_2O_2+NaOS_2O_2+4HO$ is permanent, soluble in water; is also formed when gold solution is added drop by drop to a solution of hyposulphite of soda. Formerly it was much used for toning, but is now rarely employed.

Sensitizing, *i. e.*, making surfaces of plates or papers sensitive to light, is either done in dishes or in baths, or by adding silver salt to collodion.

Sensitizing Streaks. *a.* Straight, dark streaks are formed in an old bath or an impure collodion; they manifest themselves as vertical lines in the direction of the dip.

b. Crooked, bright lines occur when plates are sensitized in dishes; they are caused when the overflowing solution becomes stagnant. (*See* Negative Process, Failures in it.)

Shellac. A resin soluble in alcohol. Commercially we have yellow shellac and white or bleached shellac. The latter has been treated with chlorine and has become more or less changed, and is partly soluble in water.

Shellac is used for making photographic varnishes (which see). The yellow shellac is to be preferred.

In order to dissolve shellac in water, we add to the alcoholic solution 3 per cent. of ammonia and dilute with water.

Silver, Metallic, occurs alloyed with copper, as bar silver or coin, partly as pure silver ; also as a gray powder, which is obtained by the precipitation of silver solution with sulphate of iron ; as such it is a part of the collodion picture. It melts at red heat. Specific gravity, 10.5. Dissolves readily in NO_5.

Silver Bath, Restoration of (*see* Restoring Bath).

Silver Bath, Conversion of into Positive (*see* Positive Bath).

Silver Bath, Negative. In summer—10 grammes of crystallized nitrate of silver, 120 grammes of water, 2.5 cubic centimetres of iodide of potassium solution 1 : 100, of nitric acid only as much as is necessary to avoid fogging.

In winter—10 grammes of crystallized nitrate of silver, 100 parts of water ; all the rest as above.

For a collodion feebly iodized, a weak bath, 1 : 15, should be used.

In warm weather more acid is necessary than in cold.

Silver Bath, Positive (*see* Positive Bath).

Silver Bath. Quantity necessary for a bath 7 inches wide and 9 inches high, 600 cubic centimetres = 1 pint ; for bath 10 inches wide and 12 inches high, 1100 cubic centimetres, about 2 pints.

In dishes 6″ by 8″ = 200 cubic centimetres, $\frac{1}{3}$ pint.
8″ by 10″ = 200–300 cubic centimetres, $\frac{1}{2}$ pint.
10″ by 12″ = 400–500 cubic centimetres, $\frac{3}{4}$ pint.
17″ by 14″ = 1000–1200 cubic centimetres, 2 pints.

In the positive process less is necessary.

Silver, Nitrate of. $AgONO_5$, the principal substance used in photography. It is prepared by dissolving me-

tallic silver in nitric acid and evaporating the solution; it melts easily, and is decomposed at red heat. Commercially it is met with as fused nitrate of silver in sticks (lunar caustic) and as crystallized nitrate of silver. For the negative bath the latter is preferable.

It is soluble in its own weight of water; in alcohol it dissolves very sparingly (100 grammes of alcohol of 95° dissolve only 3.67 grammes of nitrate of silver). The concentrated solution dissolves iodide of silver. Chloride of silver and bromide of silver dissolve much more sparingly, and in solutions 1 : 10 not at all. Pure nitrate of silver is not decomposed by light; in the presence of chloride of silver or organic substances it is decomposed.

Impurities. 1. Saltpetre. In order to discover this substance, a piece of the nitrate is heated in a porcelain crucible until it is reduced to metallic silver; it is then moistened with a little distilled water and tested with red litmus-paper. The latter should not turn blue.

2. Nitrite of silver. A little of the salt to be tested is dissolved in water, pure sulphuric acid is added in excess, and finally a solution of iodide of potassium mixed with starch paste. The latter should not turn blue. (The sulphuric acid should first be tested.) Large quantities of nitrous acid NO_3 are indicated by red fumes when sulphuric acid is added.

3. Organic substances and chloride of silver manifest themselves by being colored by light. On being dissolved in water, chloride of silver remains.

Silver, Nitrite of. Sparingly soluble salt is formed by heating fused nitrate of silver (*see* Silver, Nitrate).

Silver, Oxide of. AgO. Brown powder of an alkaline reaction. Attracts carbonic acid from the atmosphere. Formerly used for neutralizing, but at present it is not used in photography.

Silver Residues, how recovered. Of the large quan-

tity of silver which is employed in photographic operations, particularly in the positive process, we find, according to Davanne, about

a. 3 per cent. in the finished picture.

b. 7 per cent. are contained in the solid state in the filtering-paper, paper trimmings, and the pieces of paper with which drops of wasted solution have been wiped off.

c. 50 to 55 per cent. are contained in the water in which the prints have been washed after leaving the printing-frame.

d. 30 to 35 per cent. have passed into the fixing bath.

e. 5 per cent. at most are contained in the water in which the fixed pictures have been washed.

Photographers generally collect the water mentioned at c, in a barrel, and precipitate the nitrate of silver by means of common salt. A large excess of chloride of sodium (kitchen salt) should be avoided, as in this case the chloride of silver will settle very slowly.

After twenty-four hours the clear water is drawn from off the precipitate, and the silver water is collected again.

When this process has been repeated for months, the chloride of silver is collected on a cloth, washed and dried.

The silver which is collected from the waste developer solution in the negative process, may be added to the above chloride of silver.

For reducing the dried chloride of silver, the fusing process is the most suitable.

A good Hessian crucible is heated in a blast furnace to a bright red heat, and the following mixture, which must be perfectly dry, is filled into it in small quantities at a time.

Chloride of Silver (residue), . . .	3 parts.
Carbonate of Soda (free from water), .	1½ "

It is advisable to rub the crucible inside with chalk or white clay.

The fusing process (after all the residue has been placed in the crucible) is continued, until the mass, which previously has frothed violently, becomes calm. The crucible is now set aside to cool, and when cold it is broken and the silver button is taken out of it.

The fixing bath is collected separately. It is best to collect it in pots of earthenware, large enough to contain the fixing bath and the first wash water after fixing, of from four to six days' work. In each of these pots two bright copper-plates are placed opposite to each other against the side of the pot. The metallic silver will collect in forty-eight hours on these copper-plates, and can be removed with a brush. The precipitate may be removed from the plates at once, or it may remain on them until a sufficient quantity has been collected for melting; at all events, time should be allowed for the removed precipitate to settle after it has been removed with the brush.

The precipitate is filtered, according to the quantity, through paper or fine linen, and dried in the air or on a warm stove.

100 parts of the powder are mixed with 50 parts of fused and powdered borax, and 25 parts of fused and powdered saltpetre.

The saltpetre is added for the purpose of oxidizing the particles of copper which have been removed by the brush. The crucible is filled about one-third with this mixture, and if the frothing has ceased, an intense heat is maintained for about twenty minutes longer. The crucible is then set aside to cool, and then broken. The metal button contains a very little copper, which however does no harm. It can be used now for making nitrate of silver by dissolving it in nitric acid.

Papers containing nitrate of silver are collected and burned on an especially constructed hearth. The ashes are collected in a heap and exposed to heat for some time, in order to burn all the organic matter.

A mixture is now made consisting of

Ashes, ...	100 parts.
Dry Carbonate of Soda, ...	50 "
Quartz Sand, ...	25 "

The mixture fuses readily, and the yield in silver amounts to from 20 to 60 per cent. of the ashes, according to the composition of the paper.

Silver Test, Dr. Vogel's. Chemically pure iodide of potassium is dried for an hour at 80° Reaumur, in a dish which is placed over boiling water (water-bath). 10 grammes of it are carefully weighed and dissolved in 1023 grammes of distilled water.

100 cubic centimetres of this solution will precipitate exactly 1 gramme of silver, 1 cubic centimetre, $\frac{1}{100}$ grammes. For testing we take 1 cubic centimetre of the silver solution, add to it 1 drop of nitric acid, 2 drops of solution of nitrite of potash 3 : 100, and about 1 cubic centimetre of solution of starch. 1 part of arrowroot is boiled with 100 parts of water (this solution with the addition of 1 drop of carbolic acid will keep for weeks), solution of iodide of potassium is added from a graduated burette until the blue color which is formed does not disappear any more on shaking. The number of cubic centimetres of iodide of potassium which have been added from the burette will give directly the percentage of AgO,NO_5. (Vogel's *Handbook*, page 160.)

Silver Tester is a glass instrument which sinks into the silver solution according to its strength, sinking deepest into the weakest bath. The mark on the scale to which the instrument sinks indicates the strength of

the bath or the amount of nitrate of silver it contains. This test is only correct for solutions containing nothing but nitrate of silver and water; for old solutions which contain foreign substances, as nitrates, alcohol, ether, iodides, &c., the results are not reliable. Better is the silver test of Dr. Vogel.

The instrument is also superfluous, because the amount of nitrate contained in a solution may be ascertained from its specific weight by comparison with the following table:

Amount of Nitrate of Silver contained in Solution.

Percentage of Silver Salt in the solution.	Density, Water = 1.	Percentage of Silver Salt in the solution.	Density, Water = 1.
5	1.041	12	1.100
6	1.050	15	1.125
7	1.058	18	1.150
8	1.064	20	1.166
10	1.080	25	1.206

Soda, Acetate of. $NaO,C_4H_3N_3+6HO$. An easily soluble crystalline salt containing much water. It is used in the preparation of several toning baths (which see).

Soda Carbonate is commercial carbonate of soda, and either neutral or acid. The former is used for cleaning varnished plates and for neutralizing the nitrate bath and the toning bath. For the latter purpose it is necessary that the soda should be chemically pure. The simple carbonate of soda dissolves readily in water, the bicarbonate but sparingly.

Soda, Hyposulphite (*see* Hyposulphite of Soda).

Soda Phosphate and Borate. Are used for toning baths.

Specific Weight or Specific Gravity is the weight of a cubic centimetre of any substance in grammes. For determining the specific weight of liquids, we take a measure capable of containing 100 cubic centimetres of water, balance it on a scale, and fill it up to the line indicating 100 cubic centimetres with the liquid the specific gravity of which we wish to ascertain; we now weigh the liquid, and the figure divided by 100 is the specific gravity.

Example: 100 cubic centimetres of nitric acid weigh 119 grammes; this figure divided by 100 is 1.19; this is the specific weight. The amount of anhydrous nitric acid is found by referring to the table (*see* Nitric Acid). In this way we can easily ascertain, from solutions of pure sulphate of iron or pure nitrate of silver, by the specific gravity, the amount of pure salt contained therein, and the areometer becomes superfluous.

Spherical Aberration (*see* Aberration, Spherical).

Spirits of Wine (*see* Alcohol).

Spots on the Picture (*see* Failures).

Sr. The chemical symbol of Strontium.

Starch Paste (*see* Paste).

Stereoscopic Lenses, rapid-working. For this purpose lenses of portrait construction are used.

Dallmeyer recommends his patent stereographic lenses, free from distortion, angle up to 60°, diameter $1\frac{1}{2}$ inches, back focus $3\frac{5}{8}$ inches.

The front lens can be used by itself; its focus is 8 inches.

Voigtlander uses for stereos his No. 1 with $1\frac{1}{2}$ inch opening, $5\frac{1}{2}$ inch equivalent focus; relative opening 3.7.

Busch recommends the following lenses as having great light-intensity:

System II. 24 lines diameter, relative opening $\frac{1}{3}$, 6.
" III. 24 " "
" IV. 19 " "
" III. 10 " "

System IV has greater light-intensity, but not as large a field as System II and III.

For pictures where a longer exposure or much light is available, two triplets are sufficient, for instance, Busch 13 and 17 lines opening; these make a rather large picture; or two Steinheil aplanatic lenses No. 2 (with longer focus for larger pictures), or No. 1 (*see* Aplanatic Objectives).

Loescher & Petsch use for their stereoscopic pictures (gems of German life) Dallmeyer No. 2 B lenses (*see* Objectives for Portraits).

Stereoscopic Pictures. *a*, with a double camera, distance of the centres of the lenses for portraits at most but 3 inches; for landscapes, according to the distance of the foreground, it may be larger.

Size of picture *a*, ordinary size, each separate picture, $2\frac{7}{8}$ x $3\frac{1}{2}$ inches (75 x 82 millimetres); distance of the corresponding points in each picture 3 inches (78 millimetres).

b, the extra size, 3 inches x $3\frac{2}{3}$ inches (78 x 96 millimetres).

Stops are used to lessen the opening of objectives. With double objectives they are placed between the two lenses (central stops); with simple objectives they are placed in front of the lens (front stops). Stops which are permanently fixed to the objective are very practical, but this is unfortunately only exceptionally the case, and loose stops are easily lost. For landscape lenses, Sutton's oblique stop recommends itself, as, according to its position, it admits less light from the bright sky and more from the landscape. By this arrangement the illumination is equalized, and fine natural clouds are secured.

Sublimate, Corrosive. Identical with bichloride of mercury (which see).

Sulphate of Silver does not dissolve readily. It is precipitated as a white powder when sulphuric acid or

sulphates are added to a concentrated solution of silver. Frequently it is formed when a silver bath is filtered through paper containing sulphate of lime. The fine crystals which are formed when the temperature is reduced give rise to pinholes on the plate (*see* Failures).

Sulphate of the Protoxide of Iron, or Green Vitriol, $FeOSO_3+7HO$, equivalent 76. Pale green crystals, which, when exposed to the atmosphere, are oxidized and turn yellow; readily soluble in water. 1 part of the salt requires 1.64 parts of water for its solution. The turbidness of the solution is caused by oxidation. Remedy: the addition of acid. Used as developer (which see).

Sulphate of the Protoxide of Iron and Ammonia, $FeOSO_3+NH_4OSO_3+6HO$. More permanent than sulphate of iron, otherwise in its action analogous (*see* Developer).

Sulphide of Ammonium (NH_4HS) is prepared by passing sulphuretted hydrogen through ammonia. It is a stinking liquid, which rapidly turns yellow; it precipitates almost all the solutions of metals as sulphur metals (sulphurets). It is used as an intensifier, and is important for photolithography and all the processes in which a dense negative is wanted (*see* Intensification).

Sulphide of Silver. Silver sulphuret is formed by the action of sulphuretted hydrogen on a solution of silver or on metallic silver. It is insoluble, and has, when in thin layers, a yellow color, a thick deposit, looks brown or black; dissolved in nitric acid it forms sulphate of silver. In photography it is often met with when old fixing baths are decomposed by zinc metal; it is then precipitated as a black powder; it is best melted down by melting it with carbonate of soda, saltpetre, and metallic iron.

The reason why imperfectly washed pictures turn yellow is the formation of sulphide of silver; the residue of hyposulphide of soda is decomposed and sulphur is thrown out.

Sulphuric Acid is used but little in practical photography; commercially we have oil of vitriol (fuming) and English sulphuric acid. The latter has a specific gravity of 1.84 and contains in its most concentrated form $1\frac{1}{2}$ equivalents of water; when cold, crystals of HO,SO_3 are formed. Sulphuric acid carbonizes organic substances; mixed with water a very high temperature results; it decomposes with much energy muriatic acid and the phosphates and sulphates. *Use.* Mixed with nitric acid for making pyroxylin; also when mixed with 10 parts of water and 1 part of chromate of potash for cleaning plates.

Commercial sulphuric acid contains generally more water than the concentrated acid, as sulphuric acid absorbs moisture from the atmosphere very rapidly.

Sulphuric Ether (*see* Ether).

Tannin. A yellow non-crystalline mass, easily soluble in water or alcohol. The watery solution does not keep well, but turns readily mouldy; it decomposes soluble silver salts. The alcoholic solution keeps well.

Tannin Dry Process, after Russell and Sutton.

Plain Collodion.

Cotton,	0.36 grammes.
Ether,	18.75 "
Alcohol,	11.0 "

Iodizer.

Iodide of Cadmium,	1.00 gramme.
Bromide of "	0.36 "
Alcohol,	30 grammes.

Collodion.

3 parts by volume of plain collodion.
1 part " " iodizer.

Use albumenized plates.

Silver Bath.

Nitrate of Silver,	16 grammes.
Water,	200 "
Nitric Acid,	1–2 drops.

The plate is rinsed in distilled water; next, distilled water is applied with a rose; it is then coated with

Tannin,	0.9 grammes.
Water,	30 "

and dried.

Development.

a. Bicarbonate of Soda,	0.6 gramme.
Water,	30 grammes.
b. Pyrogallic Acid,	0.6 gramme.
Water,	30 grammes.

30 grammes of water are mixed with 3.75 grammes of solution *a* and 20 drops of solution *b*, and applied cold.

The picture comes out fine and clear; the plate is thoroughly washed as usual, intensified and fixed.

Tannin Solution. To make it clear, add to the tannin double its volume of water; make a paste of it; add the balance of the water hot; stir it well and filter.

Tartaric Acid is used as a substitute for citric acid in the intensifier; it acts in the same manner, but is apt to form a precipitate of tartrate of silver.

Tent (*see* Dark-Tent).

Thermometer, for measuring temperature or heat; three different kinds are used, namely, Réaumur, Celsius, and Fahrenheit. In the first, the distance between the freezing and boiling-point of water is divided into 80°; in the second the same space is divided into 100°; and in the third into 180°. In the two first the freezing-

point of water is marked 0; in the thermometer of Fahrenheit 0 is placed 32° below the freezing-point.

4° Réaumur correspond with 5° Celsius and 9° Fahrenheit. The following table will serve for comparison:

Celsius.	Réaumur.	Fahrenheit.	Celsius.	Réaumur.	Fahrenheit.
100	80.0	212.0	63	50.4	145.4
99	79.2	210.0	62	49.6	143.6
98	78.4	208.4	61	48.8	141.8
97	77.6	206.6	60	48.0	138.2
96	76.8	204.8	59	47.2	136.4
95	76.0	203 0	58	46.4	134.6
94	75.2	201.2	57	45 6	132.8
93	74.4	199 4	56	44.8	131.0
92	73.6	197.6	55	44.0	129.2
91	72 8	195.8	54	43.2	127.4
90	72.0	194.0	53	42.4	125.6
89	71.2	192.2	52	41.6	123.8
88	70 4	190.4	51	40.8	122.0
87	69.6	188.6	50	40 0	120.2
86	68.8	186.8	49	39.2	118.4
85	68.0	185.0	48	38.4	116.6
84	67.2	183.2	47	37.6	114.8
83	66.4	181.4	46	36.8	113 0
82	65.6	179.6	45	36.0	111.2
81	64.8	177.8	44	35.2	109.4
80	64.0	176.0	43	34.4	107.6
79	63.2	174.2	42	33.6	105.8
78	62.4	172.4	41	32.8	104.0
77	61.6	170.6	40	32.0	104.0
76	60.8	168.8	39	31.2	102.2
75	60.0	167.0	38	30.4	100.4
74	59 2	165.2	37	29.6	98.6
73	58.4	163.4	36	28.8	96.8
72	57.6	161.6	35	28.0	95.0
71	56.8	159.8	34	27.2	93.2
70	56.0	158.0	33	26.4	91.4
69	55.2	156.2	32	25.6	89.6
68	54.4	154.4	31	24.8	87.8
67	53.6	152.6	30	24.0	86.0
66	52.8	150.8	29	23.2	84.2
65	52.0	149 0	28	22.4	82.4
64	51.2	147.2	27	21.6	80.6

Celsius.	Réaumur.	Fahrenheit.	Celsius.	Réaumur.	Fahrenheit.
26	20.8	78.8	— 3	— 2.4	26.6
25	20.0	77.0	— 4	— 3.2	24.8
24	19.2	75.2	— 5	— 4.0	23.0
23	18.4	73.4	— 6	— 4.8	21.2
22	17.6	71.6	— 7	— 5.6	19.4
21	16.8	69.8	— 8	— 6.4	17.6
20	16.0	68.0	— 9	— 7.2	15.8
19	15.2	66.2	—10	— 8.0	14.0
18	14 4	64.4	—11	— 8.8	12.2
17	13.6	62.6	—12	— 9.6	10.4
16	12.8	60.8	—13	—10.4	8.6
15	12.0	59.0	—14	—11.2	6.8
14	11.2	57.2	—15	—12.0	5.0
13	10.4	55.4	—16	—12.8	3.2
12	9.6	53.6	—17	—13.6	1.4
11	8.8	51.8	—18	—14.4	— 0.6
10	8.0	50.0	—19	—15.2	— 2.2
9	7.2	48.2	—20	—16.0	— 4.0
8	6.4	46.4	—21	—16.8	— 5.8
7	5.6	44.6	—22	—17.6	— 7.6
6	4.8	42.8	—23	—18.4	— 9.4
5	4.0	41.0	—24	—19.2	—11.2
4	3.2	39.2	—25	—20.0	—13.0
3	2.4	37.4	—26	—20.8	—14.8
2	1.6	35.6	—27	—21.6	—16.6
1	0.8	33.8	—28	—22.4	—18.4
0	0 0	32.0	—29	—23.2	—20.2
—1	—0.8	30.2	—30	—24.0	—22.0
—2	—1.6	28.4			

Toning Bath. Take of—

Chloride of Gold and Potassium,	1 part.
Water,	50 parts.

Of this normal gold solution it is calculated that 3 cubic çentimetres = 50 grammes are necessary per sheet of paper.

1. Bath for violet tones, per sheet of paper. Take of—

Normal Gold Solution (50 grains),	3 cub. centim.
Water (7 ounces),	200 "
Borax (22 grains),	1½ gramme.

The bath should always be used fresh.

2. For brown to violet tones:

Normal Gold Solution (50 grains),	3 cub. centim.
Water (7 ounces),	200 "

Chemically pure Carbonate of Lime, as much as can be placed on the point of a knife.

Shake and filter. The bath will keep.

3. For black tones (see also No. 5):

Normal Collodion (50 grains),	3 cub. centim.
Solution of Crystallized Carbonate of Soda 1 : 50 (50 grains),	3 "
Water (7 ounces),	200 "

The bath should always be used fresh.

4. For brown tones:

Normal Gold Solution (50 grains),	3 cub. centim.
Crystallized Acetate of Soda (50 grs.),	3 grammes.
Water (7 ounces),	200 cub. centim.

The bath may be used after twenty-four hours. It keeps.

5. For black to purple-brown tones:

a. The same as No. 4, to which is added 0.5 gramme of chloride of lime. It should be set aside for three hours.

b. According to Grasshoff, take of—

Distilled Water (1.76 pint), . . .	1000	grammes.
Acetate of Soda twice fused (150 grs.),	10	"
Chloride of Lime (4 grains), . . .	$\frac{1}{4}$	"
Chloride of Gold, or Chloride of Gold and Potassium (16 grains), . .	1	"

It should be well shaken and not be used until one hour after making it; it is better not to use it until the following day. Take a few spoiled prints (about six to eight card size are sufficient) and throw them, without being washed, into the bath, and let them remain in it from ten to fifteen minutes. The bath will become muddy and the prints will become strangely colored. After removing these prints, the toning goes on in the ordinary way: the bath tones very rapidly the first few days; but care should be taken that the color is not taking too blue. One gramme (16 grains) of gold will tone about 11 to 12 sheets of paper.

When the bath begins to tone slowly, gold may be added at the rate of about 1 gramme, or 15 to 16 drops, of a solution of 1 part of chloride of gold, or chloride of gold and potassium, to 50 parts of water, for every sheet of paper. If now and then, say every four or six days, a very small quantity of chloride of lime is added ($\frac{1}{10}$ to $\frac{1}{20}$ gramme $= \frac{3}{4}$ to $1\frac{1}{4}$ grain is a good deal), the bath will yield blacker tones. It should be filtered every three or four days.

6. Sulphocyanide of gold toning bath:

Normal Gold Solution (50 grains), .	3 cub. centim.
Sulphocyanide of ammonium, previously dissolved in 100 to 200 cubic centimetres ($3\frac{1}{2}$ to 7 ounces) of water (300 grains), ...	20 grammes.

For further particulars about the action of toning baths, see Vogel's *Handbook*, page 137.

Traumaticin. Solution of 1 part of gutta-percha in 12 parts of chloroform.

Transfer Paper—permanent, sensitive to light; Talbot paper.

Transfer paper is the simple old process of Talbot, by which drawings are copied directly on sensitive paper. The drawings are placed in the printing-frame on the sensitive paper, the pictures being uppermost, and both are pressed together and exposed. The drawing copies as a negative, which is of course a reverse of the drawing. The picture does not need to be toned, but only requires to be fixed and washed. The negative is suited for a good many purposes, but a positive may be made by repeating the process.

Transferring Negatives, *i. e.*, detaching the film from the glass (for the purpose of printing from the back).

a. With a tough, leathery collodion, take of—

Alcohol, ...	50 parts.
Ether, ...	50 "
Cotton Pyroxylin, ...	3 "
Castor Oil, ...	2 "

The negative which is to be transferred, and which should not be varnished, is first coated with a caoutchouc solution 1 : 50 and dried. The above collodion is now poured over it and dried. The film is detached readily with a penknife, and also by placing it in water.

From varnished plates the varnish has first to be removed. Warm alcohol of 90° strength should be poured over it several times, a caoutchouc coating is applied next, and finally a coating of the above collodion.

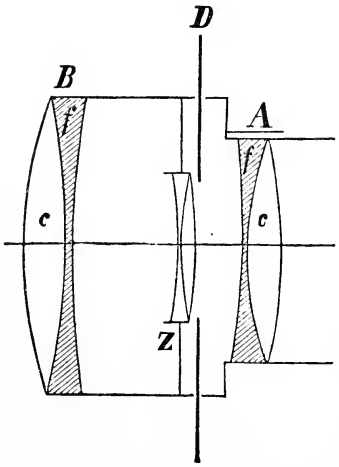
b. With gelatin.

Ten parts of gelatin are dissolved in 100 parts of hot water and placed on a warm unvarnished plate, which is kept in a horizontal position. The gelatin solution should be poured on to the thickness of about a millimetre; it is left to dry, and plain collodion, containing 1 per cent. of pyroxylin, is poured over it. The film is detached with a knife on one side and drawn off.

Transparent Photographs (*see* Diapositives).

Triplets consist of a front lens A, a larger back lens B, and between these the lens Z, with a moderate opening (one-tenth of the focus). They have a moderately

Fig. 15.



large and flat field up to 45°, and without distortion; they are principally used for taking architectural views and copying drawings; they can be used also without the intermediate lens Z.

The focus is then shorter; the light-intensity four times greater; the field is, however, without the intermediate lens much curved.

Lately the aplanatic lens (which see) has been used more generally.

Universal triplet lenses, constructed by Busch, have a much larger intermediate lens than the ordinary triplets; they have hence a much greater light-intensity (about three times greater) than the ordinary triplets, and are therefore suited for portraits (with a good light) and for landscapes, &c.

They draw correctly, and make a picture of about the length of the focus; opening about one-seventh; field of picture generally 45°; field of view, 72°.

Dallmeyer constructed an analogous triplet, but abandoned it afterward, as his patent lens system D has greater light-intensity.

Tunnel Atelier consists (in contrast to the north front atelier) of a long dark space, which runs from south to north. At the southern end it opens into a glass-house, which is formed by a glass roof inclining towards the north, and an eastern or western glazed side; the southern side is formed of masonry, and forms the background. The apparatus is placed in the dark passage.

Such ateliers have frequently been built, but practically they have proved inferior to the north-front ateliers. We recommend therefore the latter.

Universal Lenses. A favorite name for portrait lenses, which also can be used for landscapes. (*See* Portrait Objectives.)

Ur. The chemical symbol of uranium.

Uranium, bromide of silver. Collodion process (according to Wortley); a modification of the collodio-bromide process.

Collodion:

Plain Collodion, . .	300 grammes,	10 ounces.
Bromide of Cadmium (dry),	4.3 "	76 grains.
Nitrate of Uranium, . .	18.5 "	5 drachms.
Nitrate of Silver, . .	11 "	3 "

Manipulations the same as with the collodio-bromide process (which see).

Coating the Plate (preservative).

Tannin, ...	5 grammes,	80 grains.
Gum Arabic, . . .	3 "	48 "
Sugar, ...	2 "	32 "
Water, ...	240 "	8 ounces.
Gallic Acid, . . .	15 "	4 drachms.

The gallic acid solution consists of 1 part gallic acid in 20 parts of alcohol.

Development:

Water, ...	20 grammes,	320 grains.
Alcohol, ...	8 "	128 "
Alcohol-Pyrogallic Solution, 1 : 10, .	$2\frac{1}{2}$ gram.	(40 grs.)
Carbonate of Ammonium Solution, 1:8,	$1\frac{1}{4}$ "	20 "
Bromide of Ammonium Solution, 1 : 8	2	drops (2 min.)

The pyrogallic, water and alcohol solution are first left to act by themselves, and the ammonia and bromide of ammonium solutions are added later. With overexposed plates, more bromide of ammonium is used; with underexposed plates, more pyrogallic acid solution is used.

Varnish for Negatives. *a.* Common varnish:

Bleached Shellac, ...	10 parts.
(Unbleached is preferable; it keeps better, and the slight yellow color does not interfere.)	
Elemi, ...	3 parts.
Alcohol, ...	100 "

b. A varnish which does not split or tear, is recommended by Kilburn :

Alcohol, ...	1220 parts.
Shellac, bright yellow, . . .	180 "
Sandarac, ...	22 "

For every ounce of this solution add 1 to 2 drops of castor oil ; this makes the varnish more pliant. An hour after the varnish has been poured upon the negatives, the latter is ready for the printing-frame.

c. Benzole varnish :

Benzole, ...	10 parts.
Alcohol, 95°, ...	100 "

d. Mix *a* and *b* ; this also makes an excellent varnish.

e. Copal varnish :

Copal, ...	1 part.
Benzine, ...	2 parts.

(*See* Copal Varnish.)

f. Amber varnish. Yellow amber is carefully fused in a covered dish, and dissolved in benzine ; the solution requires sometimes more, at others less benzine.

a is most generally employed ; *e* is recommended as a preliminary coating ; *d* and *e* dry slowly.

The Commission to test the merits of varnishes, appointed by the Society for the Promotion of Photography, does not recommend sandarac varnishes.

Varnish, red or yellow, for covering negatives (*see* Dragon's Blood and Varnish, Iodine).

Varnish, dull, for taking the lead-pencil readily for retouching purposes is prepared, according to Lea, by adding 1 per cent. of tartaric acid to ordinary negative varnish. A better way is to dilute ordinary varnish with

three times its volume of alcohol, and to apply it over a coating of dextrine solution.

g. A dull varnish for retouching is made, according to Hughes:

Ether,	7 ounces.
Benzine,	3 "
Sandarac,	½ ounce.
Canada Balsam,	1 drachm.

The resins are dissolved in ether, and the benzine is added afterwards.

Varnish, Consumption of, for Negatives per square foot = $\frac{1}{10}$ square metre, 7½ cubic centimetres.

Varnish, Iodine, for covering the back of the negative with a yellow film, ½ to 1 part of iodine to 100 parts of negative varnish.

Victoria Size, Objective for (*see* Portrait Objectives).

Victoria Size. Picture, 3 inches by 4¼ inches; size of the mount, 3¼ x 5 inches.

Visite, Carte de, Objective for (*see* Portrait Objectives).

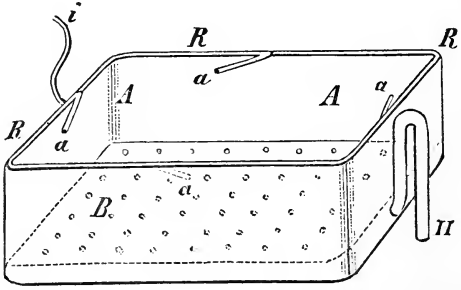
Visite, Carte de. Size of picture about 2¼ x 3¾ inches; size of mount, 2½ x 4¼ inches.

Washed Wet Plates (*see* Plates, Washed).

Washing Apparatus for Washing Prints. The most practical one is described in Vogel's *Handbook*, page 149. A japanned tin case (Fig. 16) is provided with a double bottom *B*, perforated with holes; on the lowest point a siphon *H* is attached; around the upper margin a tube *R* is placed, connected with the water supply-pipe *i*, and the slanting openings *a a a a*. The tube *R* contains also holes near the sides of the case, in order to float off the pictures that may adhere to the sides.

When the box is connected with the water supply, it will be filled with water. As soon as it reaches the height of the siphon *H*, the latter commences to act,

FIG. 16.



and empties the case in a few minutes, when the operation repeats itself.

A small number of pictures is washed completely in one hour. For test for complete washing, *see* Soda Test.

Waxing Papers. These papers are placed on clean hot metal plates, and rubbed with a cake of pure white wax. They are afterwards smoothed between blotting-paper with a hot smoothing-iron.

Weights in Photography. Two systems of weights are in use:

1 ounce = 8 drachms = 24 scruples = 480 grains.

1 kilogramme = 2 pounds = 1000 grammes.

1 gramme = 10 decigrammes = 100 centigrammes = 1000 milligrammes.

1 drop (English minim) is about equal to 1 grain = 6 centigrammes.

English and American formulæ are generally given in ounces and grains. The following table facilitates the conversion of the one system into the other:

English Weight.	Decimal or French Weight.
Grain 1	6.25 centigrammes.
" 2	12.5 "
" 3	18.75 "

French Weight.	English Weight.	
1 gramme.	16 grains.	
2 "	32 "	
3 "	48 "	
4 "	64 "	
5 "	80 "	
6 "	96 "	
7 "	112 "	
8 "	128 "	
9 "	144 "	
10 "	160 "	
11 "	176 "	
12 "	192 "	
13 "	208 "	
14 "	224 "	
15 "	240 "	= 4 drachms.
16 "	256 "	
17 "	272 "	
18 "	288 "	
19 "	304 "	
20 "	320 "	

Whey Process. Very well suited for enlargements with development. The paper is bathed for two minutes in a solution of

Iodide of Potassium, . . .	2 grammes.
Bromide of Potassium, . . .	1 gramme.
Whey of Milk, filtered, . . .	100 grammes.

The paper is then dried. The paper keeps for an indefinite length of time; for use it is sensitized in

Nitrate of Silver, (In winter 40 grammes.)	30 grammes.
Water,	500 "
Glacial Acetic Acid,	2–10 "

according to temperature or a tendency to fogging; when moist it is stretched and exposed. Duration of exposure in the solar camera, 15 seconds to 1 minute, according to the thickness of the negative.

Development:

Pyrogallic Acid,	3 grammes.
Glacial Acetic Acid,	150 "
Water,	1000 "
Bromide of Potassium,	1–2 "

The picture is placed on a glass-plate and the mixture poured over it. In order to check a too strong development, a diluted solution of common salt is applied.

Wide-Angled Aplanatic Lenses. Steinheil furnishes the following notes: The construction makes it particularly adapted to the reproduction of maps and drawings, as also for taking landscapes, with the aid of the prism, for the printing processes. The lens is comparatively small, very accurate; the pictures are flat and free from distortion. The light-intensity, however, is less than the ordinary aplanatic lens, but it has a larger field of view.

The numbers having less than 19 lines (42.9 millimetres) opening will be furnished later, and will be announced by special circulars.

No. 9. Opening, 19 lines (42.9 millimetres); focus, 65.0 centimetres; size of picture, 16 inches.
No. 10. Opening, 28 lines; focus, 36 inches; size of picture, 22 inches.
No. 11. Opening, 33 lines; focus, 45 inches; size of picture, 28 inches.
No. 12. Opening, 40 lines; focus, 55 inches; size of picture, 34 inches.

Wide-Angled Lenses, of extraordinary large field of view, to 90° and more, are particularly useful for taking pictures at very short distances. The foreground appears often too wide, and when the apparatus can be placed at a sufficient distance these lenses should not be used.

The best known are the Globe lens, the Zentmayer lens, and Busch's pantascope; the latter is in Germany most generally used. Steinheil's periscope has a difference of focus.

The wide-angled lenses have only a small opening, but consequently great depth of focus and are feeble in light. They work with small stops.

Dallmeyer has constructed a wide-angled rectilinear lens, which is similar to the Steinheil pantascope.

Dallmeyer's single wide-angled lens (*see* Landscape Lenses).

Zentmayer's lens is used to a large extent in America.

Yellow Varnish for covering negatives (*see* Iodine Varnish, Iodine and Dragon-blood Varnish).

Zentmayer Lens (*see* Wide-angled Lenses).

Zn. Symbol of Zinc.

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" 3— 5½	"		6½ x 8½	"	30 00	" 3 " 4 "			55 00
" 4— 8	"		10 x 12	"	42 00	" 4 " 5 "			75 00
" 5—12	"		14 x 17	"	60 00	" 5 " 6 "			110 00
" 6—18	"		20 x 24	"	90 00	" 1, 2, and 3 "			48 00
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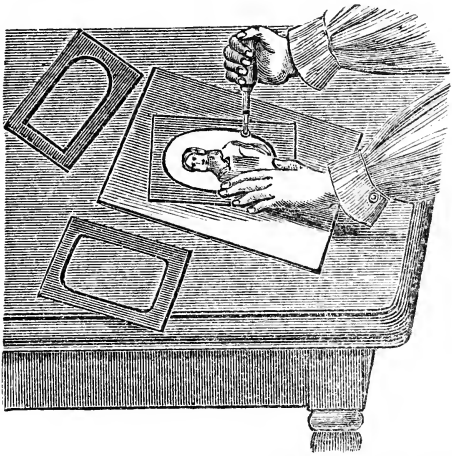

off the waste paper, and leaves the print with a neatly beveled edge which facilitates the adherence of the print to the mount. Try one and you will discard the knife and punch at once. For examples of work see Dr. Vogel's picture in the January number of the *Philadelphia Photographer*, and Messrs. Schreiber & Sons' picture in the February issue of the same magazine. Likewise the various proofs in other numbers. Sent by mail, neatly boxed, for $3.50. Sent to any part of the world on receipt of price. *Oil the wheel bearings with sewing machine oil.*

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